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Kinoshita et al.

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(45) **Date of Patent: Oct. 27, 2009**

(54) **IMAGE FORMING APPARATUS AND SHEET HEATING APPARATUS**

(75) Inventors: **Hidehiko Kinoshita**, Kashiwa (JP); **Jun Yamaguchi**, Toride (JP); **Atsushi Nakagawa**, Toride (JP); **Masaaki Moriya**, Moriya (JP)

(73) Assignee: **Canon Kabushiki Kaisha**, Tokyo (JP)

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(30) **Foreign Application Priority Data**

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(51) **Int. Cl.**
G03G 15/00 (2006.01)
G03G 15/20 (2006.01)

(52) **U.S. Cl.** **399/19**; 399/341

(58) **Field of Classification Search** 399/19, 399/20, 21, 67, 68, 322, 341, 405, 407
See application file for complete search history.

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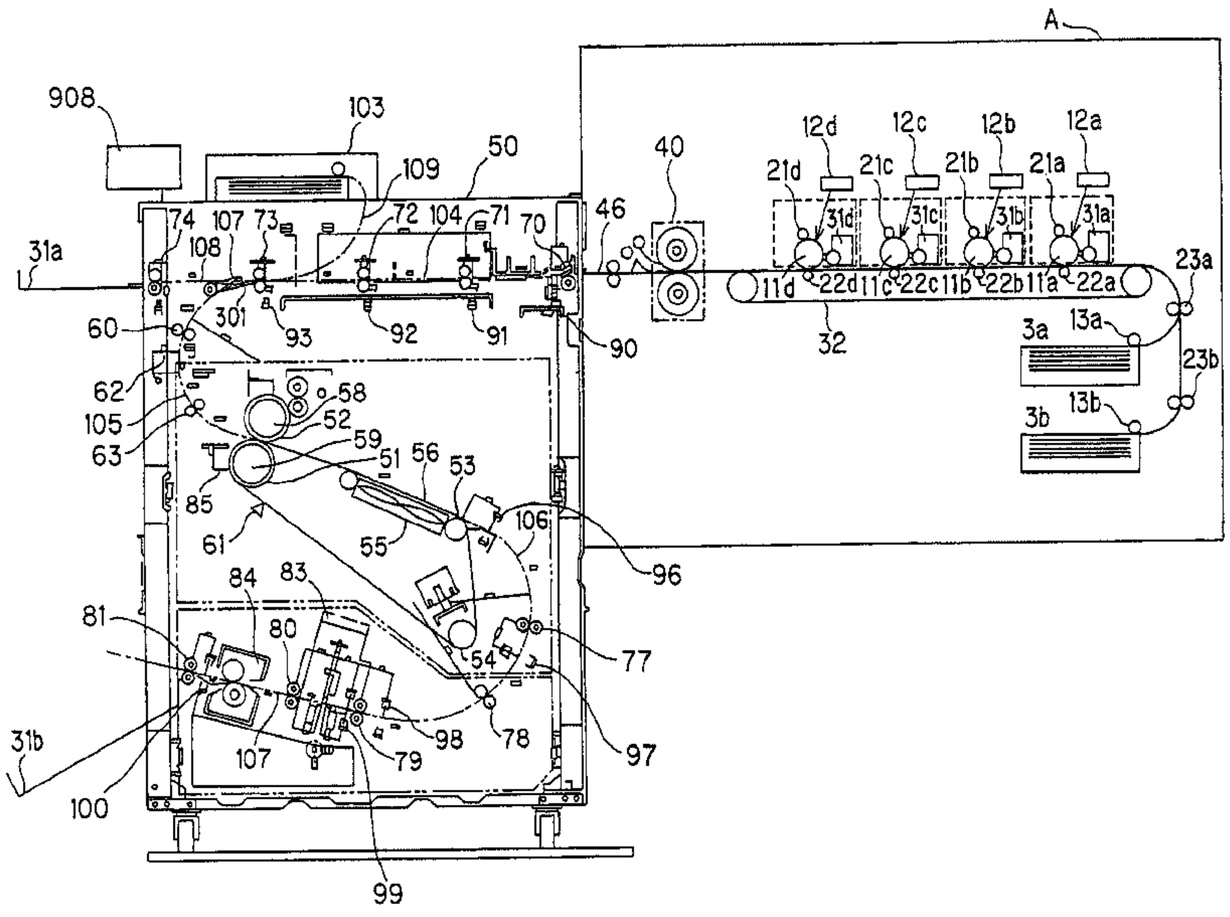
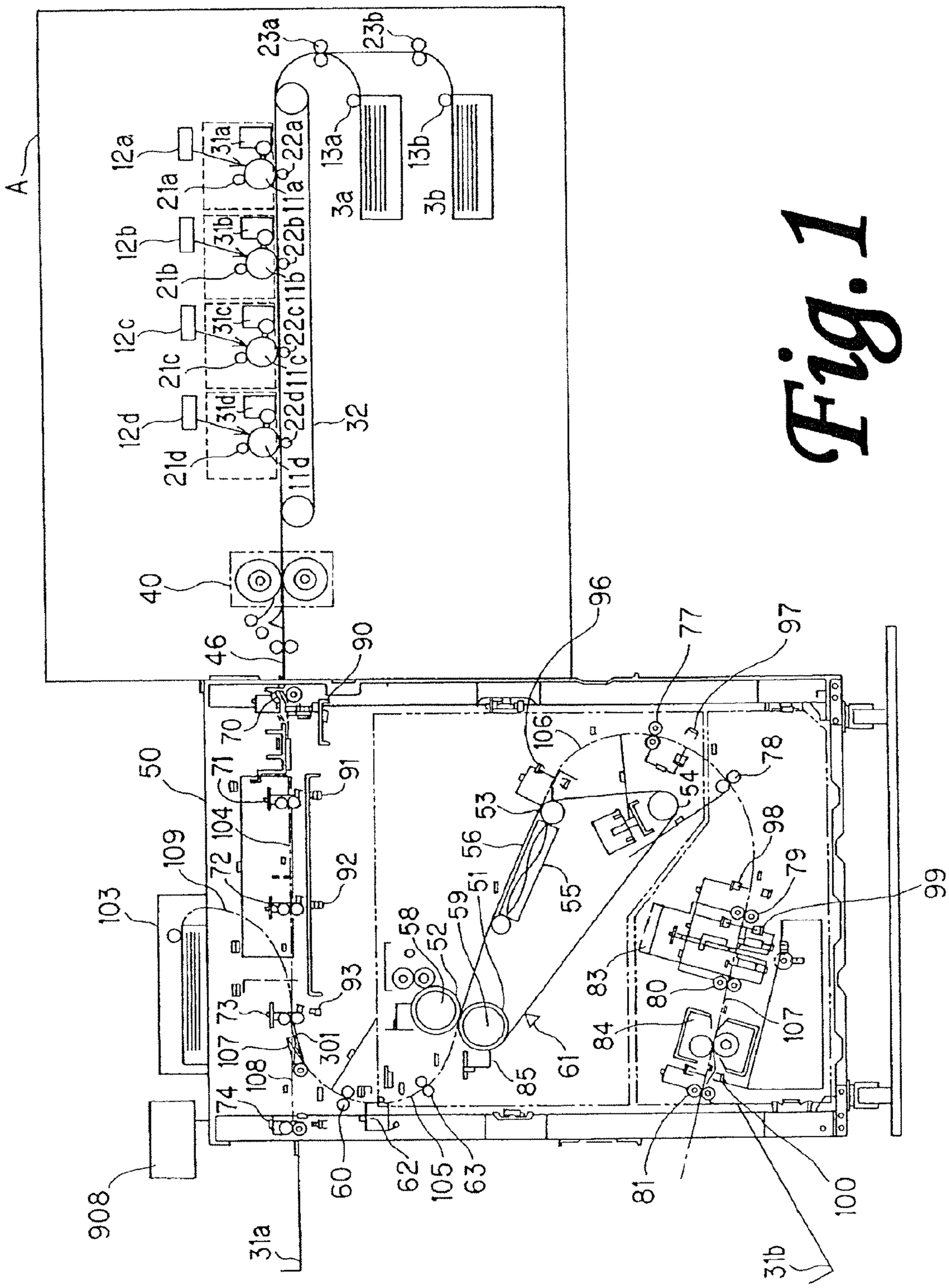
Primary Examiner—Robert Beatty
(74) *Attorney, Agent, or Firm*—Fitzpatrick, Cella, Harper & Scinto

(57) **ABSTRACT**

When an abnormality factor occurs in a second heating device, a sheet located upstream of a branch portion is discharged onto a discharge tray through a second conveying path. After the abnormality factor in the second heating device is removed and the sheet discharged to the discharge tray through the second conveying path is set in a paper refeeding tray, a sheet feeding portion feeds the sheet set in the paper refeeding tray to the second heating device.

13 Claims, 17 Drawing Sheets

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11a
3a
3b
12b
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22b
21b
11b
12c
31c
22c
21c
11c
12d
31d
22d
21d
11d
32
40
46
90
96
77
97
70
106
50
71
91
78
104
53
54
109
56
98
72
92
51
55
79
99
103
58
52
59
83
93
80
73
301
107
84
61
107
108
85
74
60
62
105
63
81
100
908
31a
31b

Fig. 1

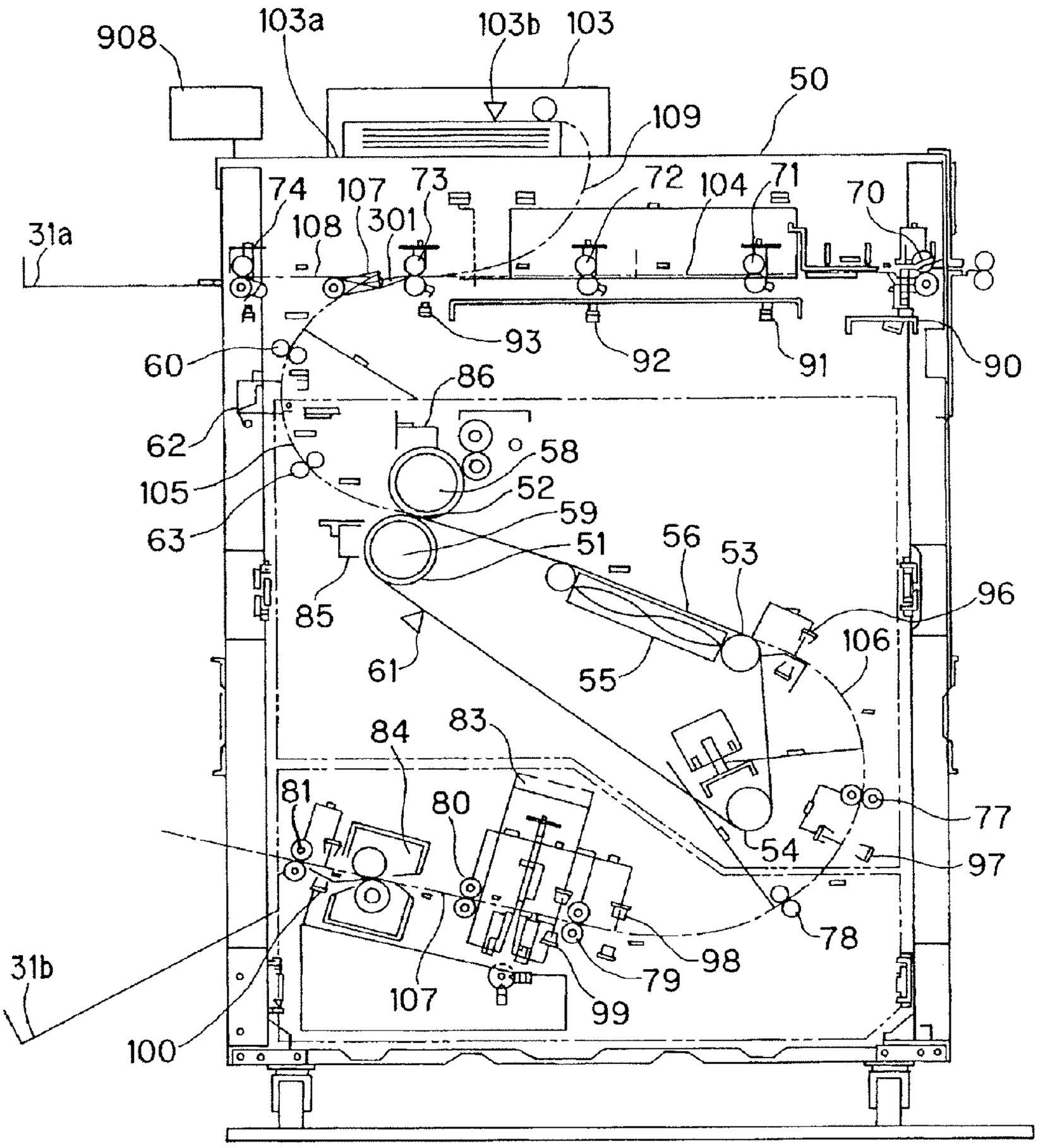

908
103a
103b
103
50
109
74
107
73
72
104
71
70
108
301
31a
A
93
92
91
90
60
86
62
58
105
52
59
63
51
56
53
96
85
106
61
55
84
83
81
80
77
54
97
78
98
79
107
99
31b
100

Fig.2

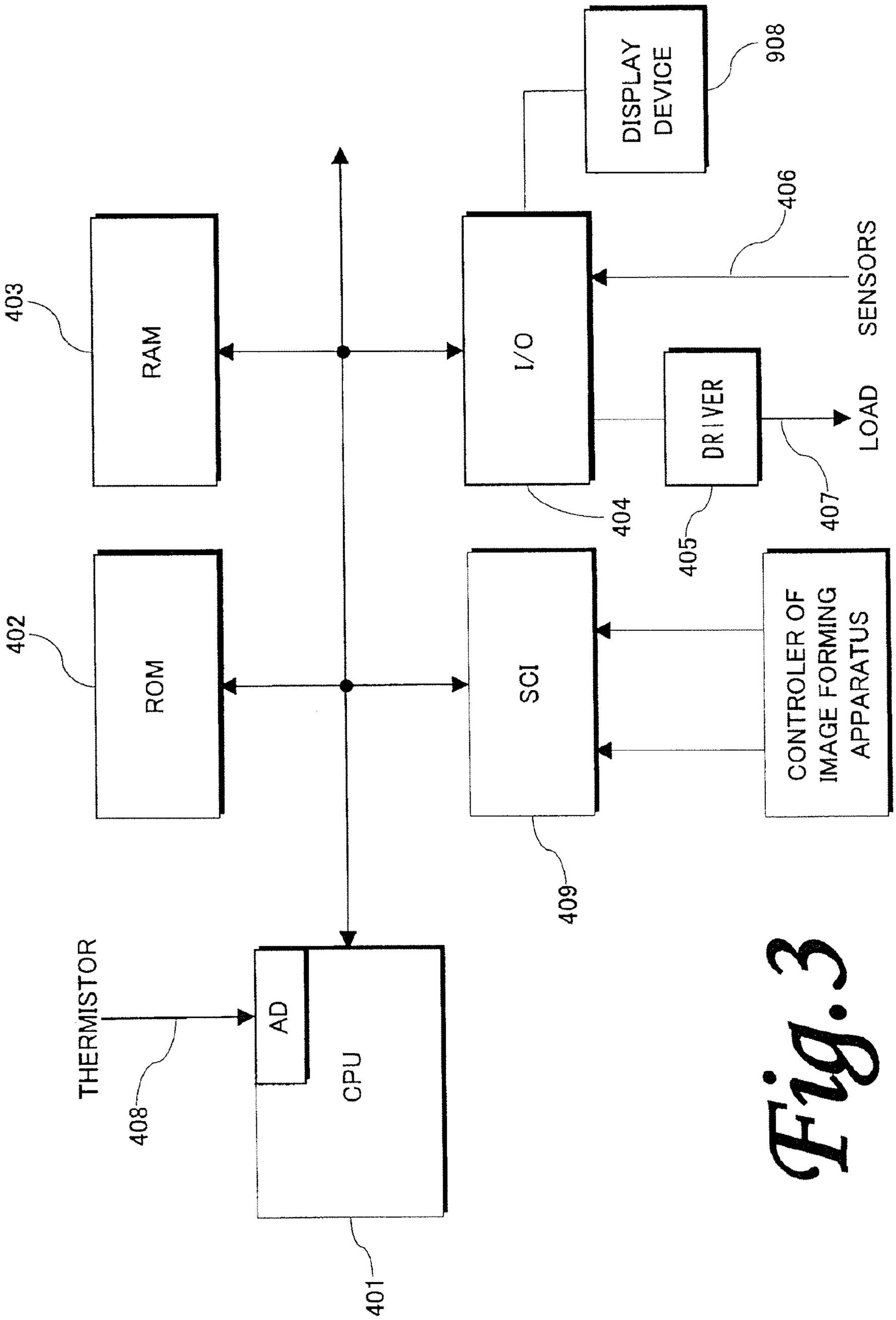

DISPLAY DEVICE
908
406
SENSORS
403
RAM
I/O
DRIVER
LOAD
404
405
407
402
ROM
SCI
CONTROLER OF IMAGE FORMING APPARATUS
409
THERMISTOR
408
AD
CPU
401

Fig. 3

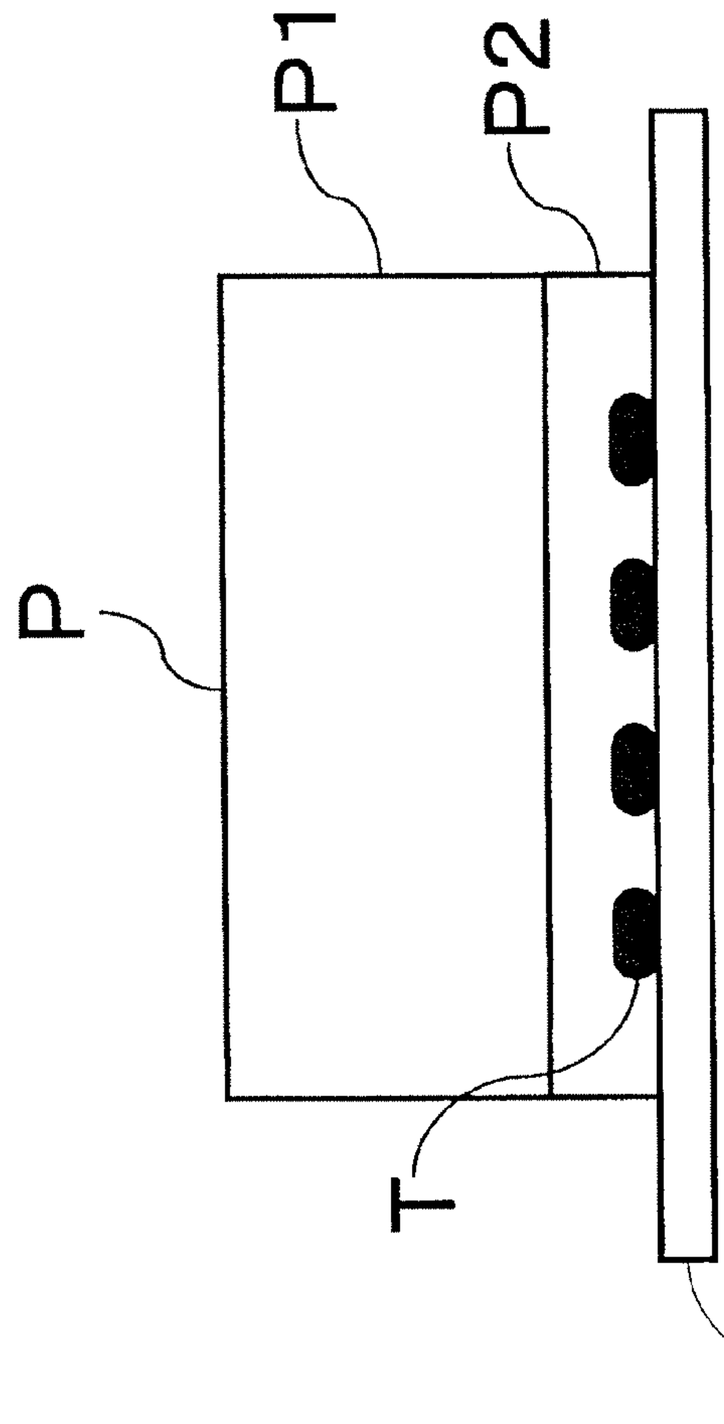


Fig. 4B

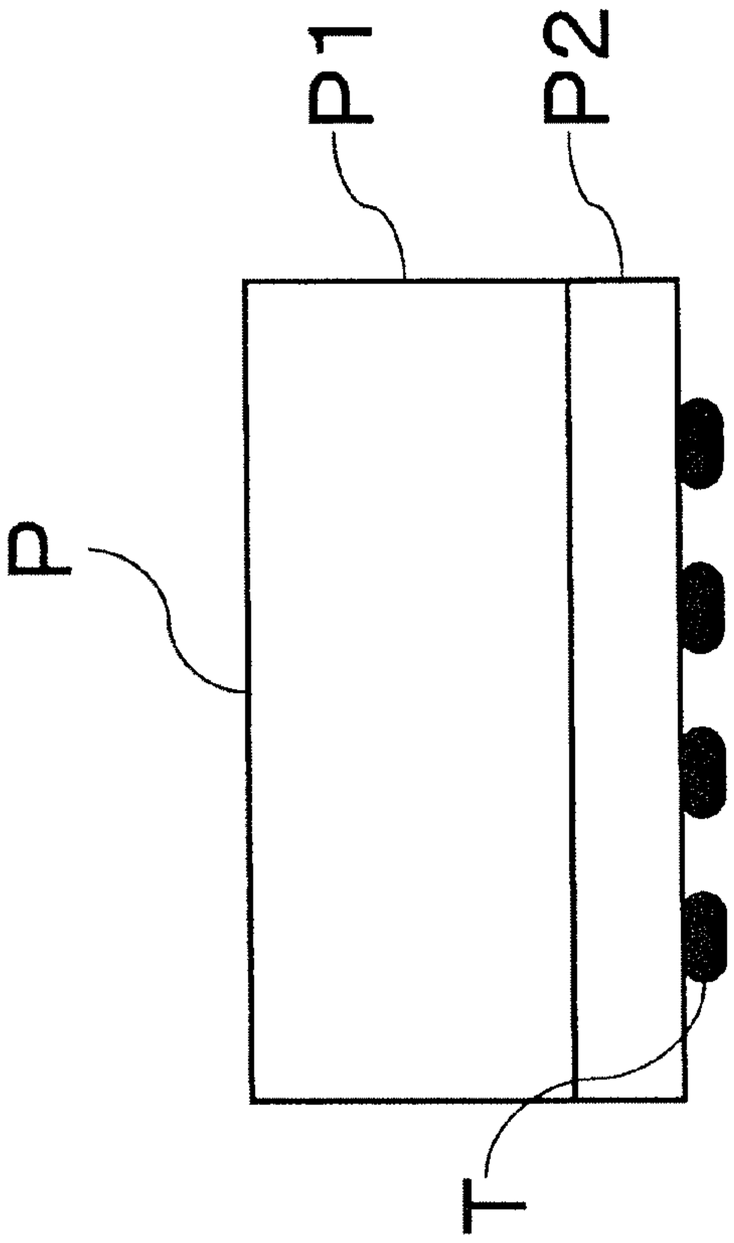


Fig. 4A

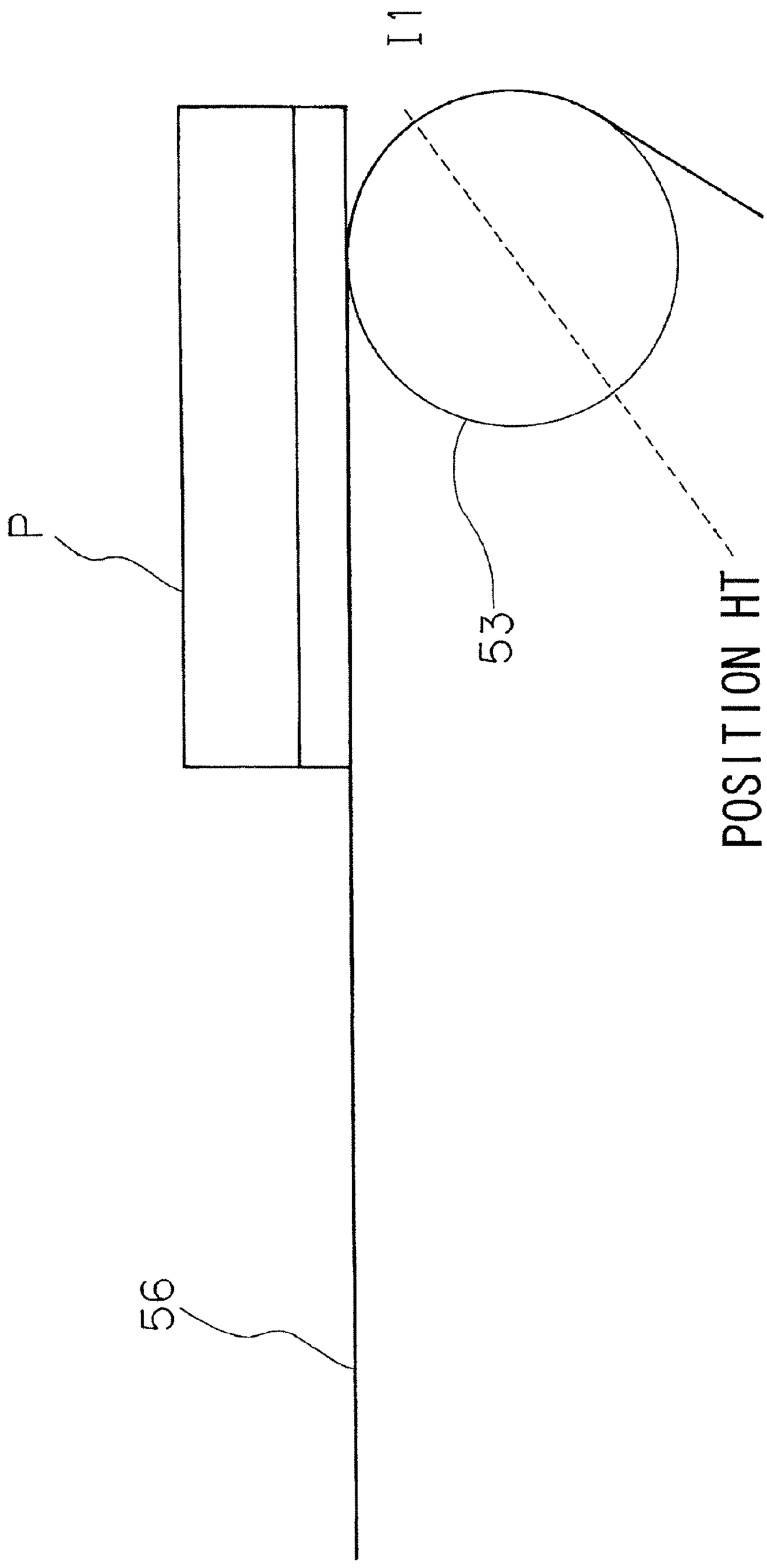
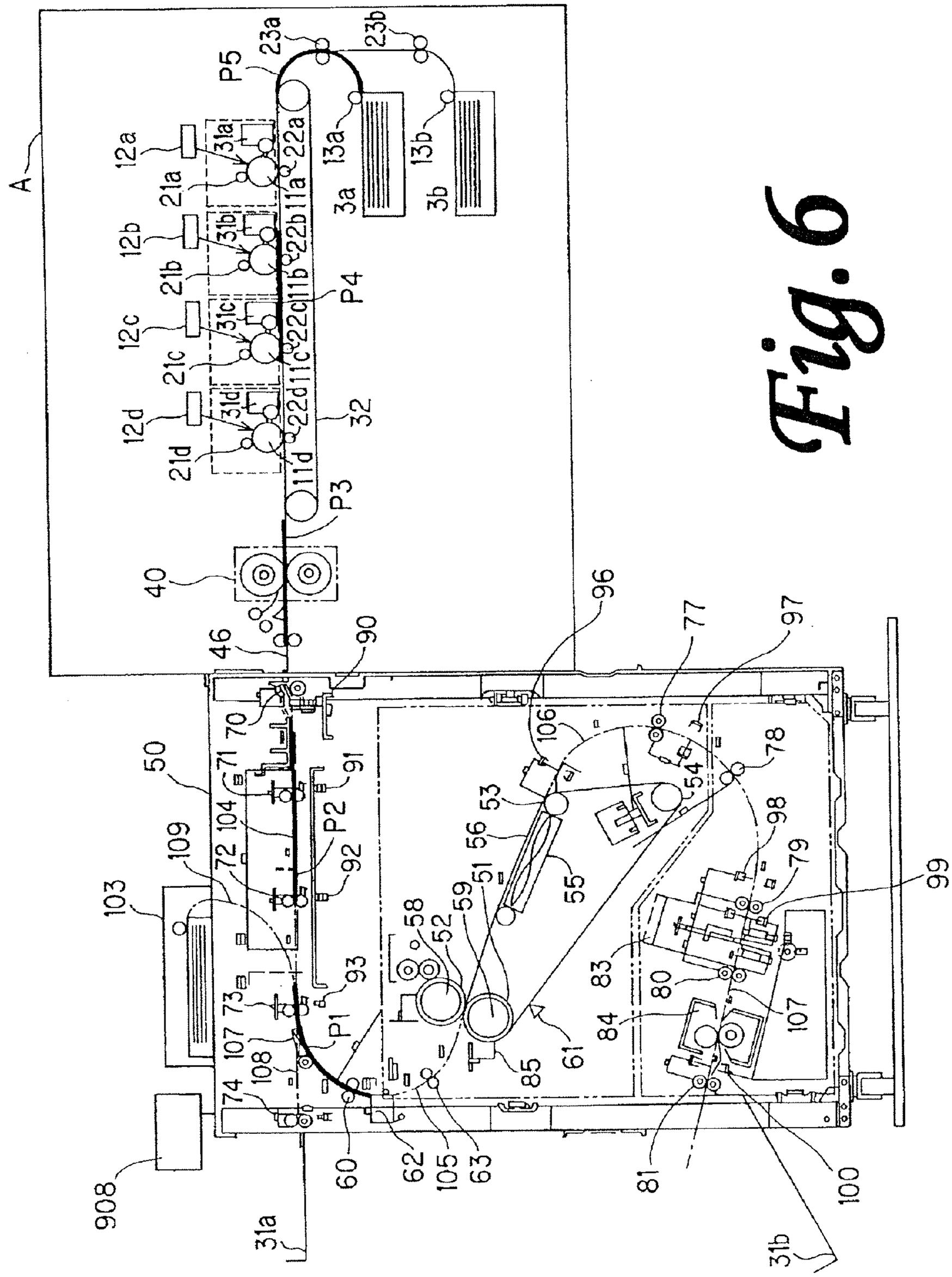


Fig. 5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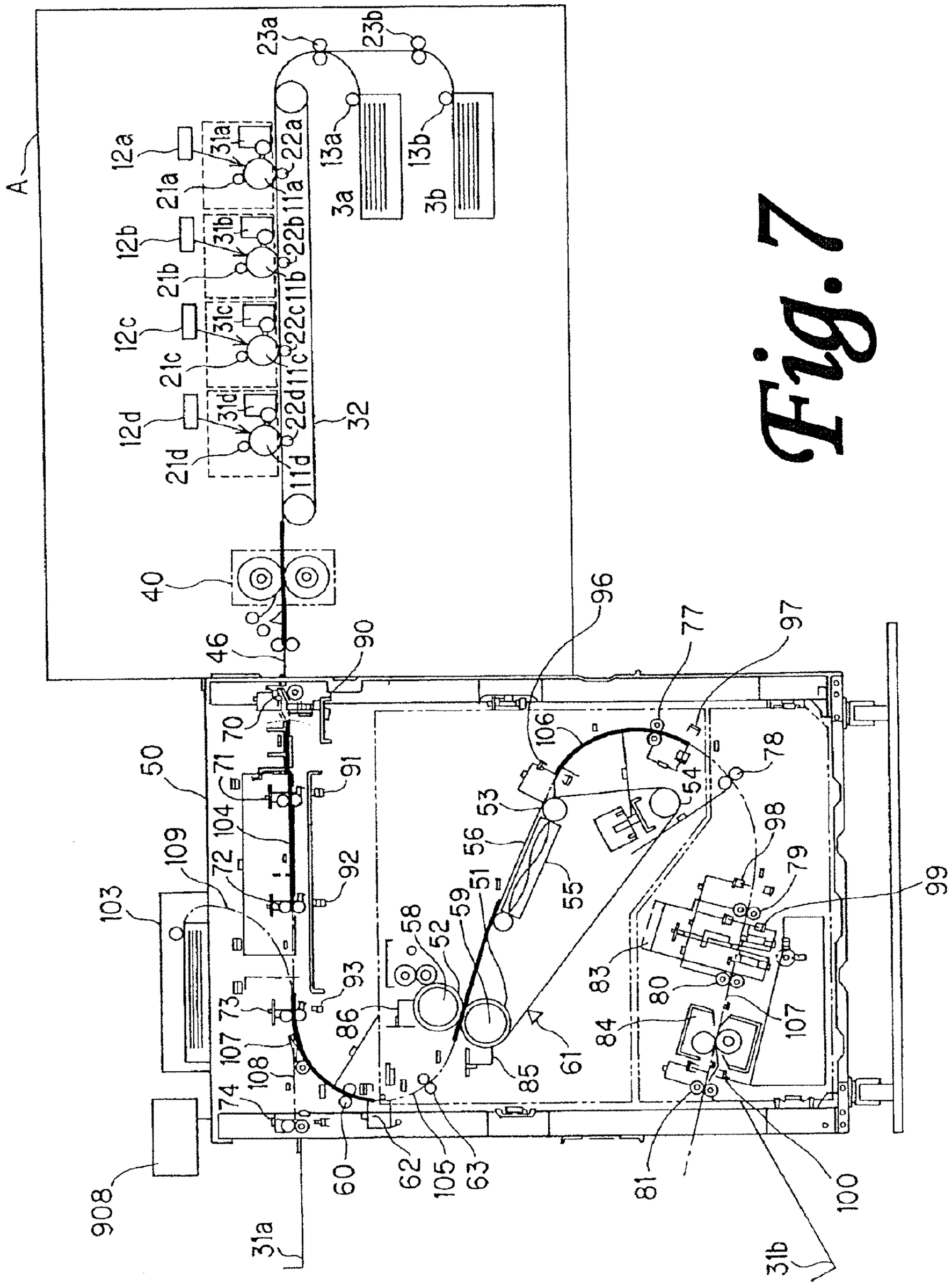
P5
23a
23b
12a
31a
21a
22a
11a
13a
13b
3a
3b
12b
31b
21b
22b
11b
P4
12c
31c
21c
22c
11c
12d
31d
21d
22d
11d
32
P3
40
46
90
70
71
91
50
104
P2
109
72
92
103
96
77
97
106
78
54
53
56
98
51
55
79
99
58
52
59
83
80
107
84
61
85
73
P1
93
107
108
74
60
62
105
63
81
100
908
31a
31b

Fig. 6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12a
21a
31a
22a
23a
23b
13a
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3a
3b
12b
21b
31b
22b
11a
12c
21c
31c
22c
11b
12d
21d
31d
22d
11c
11d
32
40
46
90
96
77
97
70
71
106
78
50
91
104
53
54
109
72
56
98
92
51
55
79
103
58
52
59
99
93
83
73
86
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107
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107
108
85
74
60
62
105
63
81
100
908
31a
31b

Fig. 7

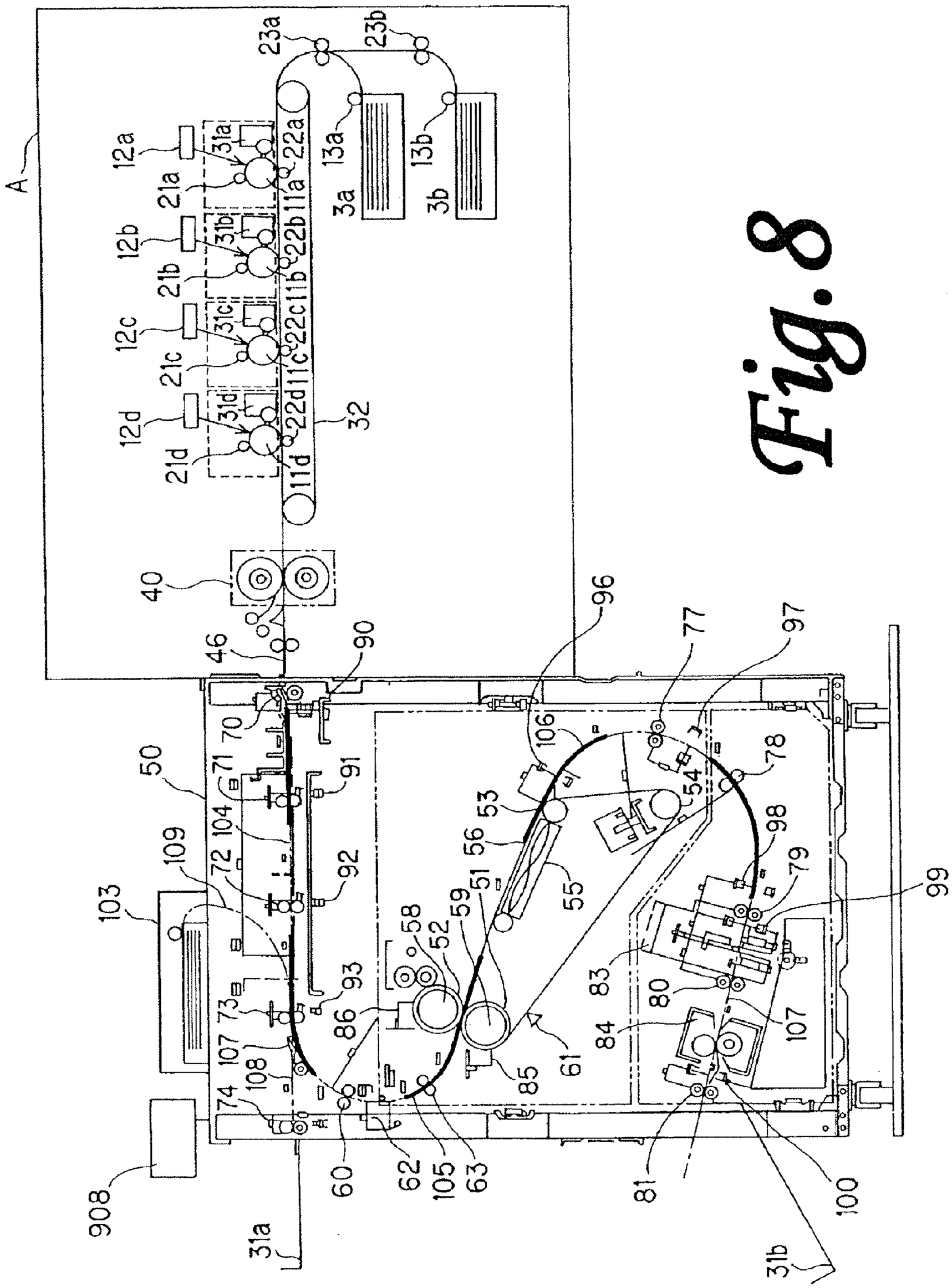
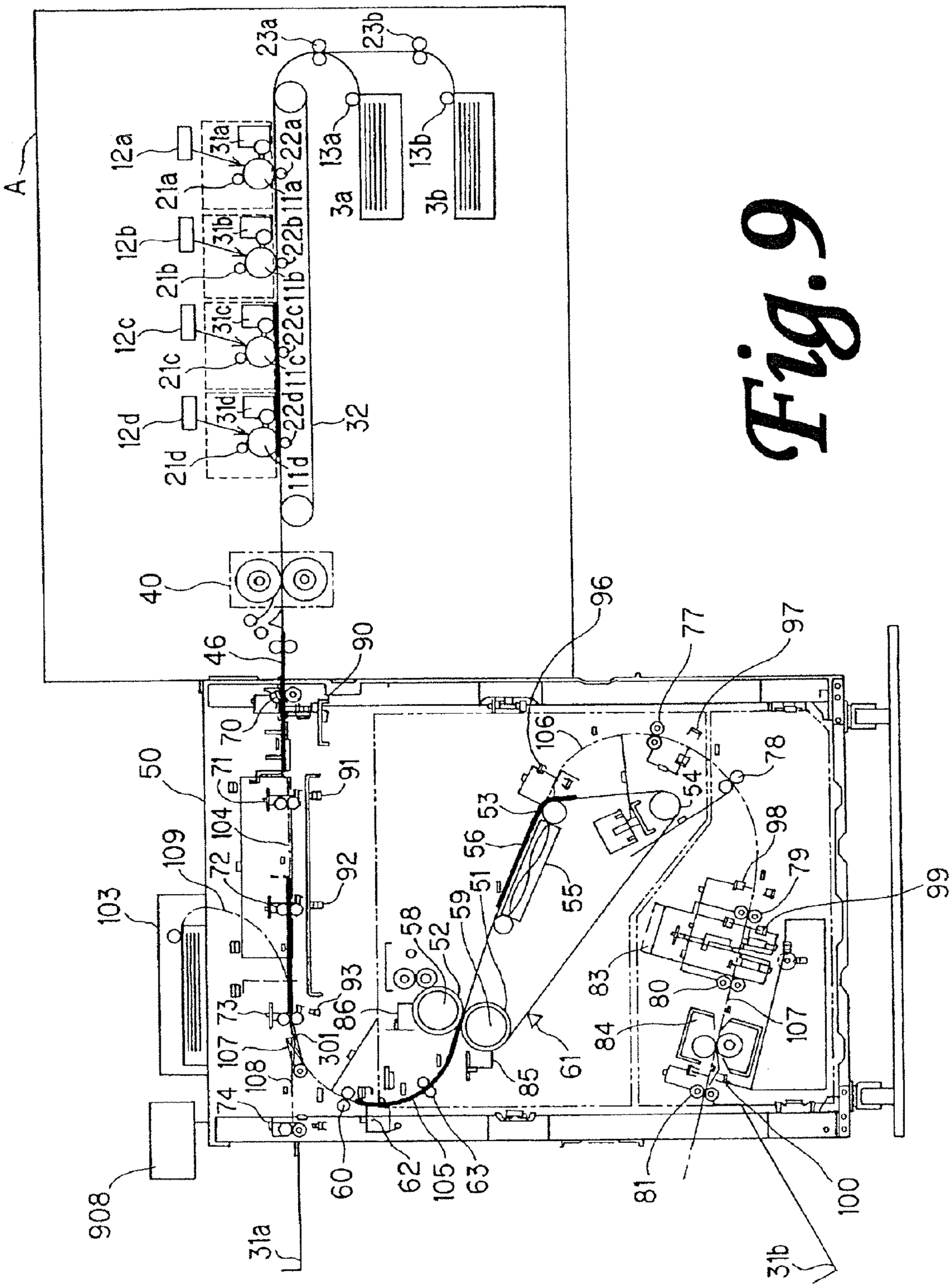

A
23a
23b
12a
31a
21a
22a
11a
13a
13b
3a
3b
12b
31b
21b
22b
11b
12c
31c
21c
22c
11c
12d
31d
21d
22d
11d
32
40
46
90
96
77
97
70
106
50
71
91
78
104
53
54
109
72
92
98
56
51
55
79
99
103
58
52
59
93
83
80
73
86
84
107
107
108
61
85
74
60
62
105
63
81
100
908
31a
31b

Fig. 8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31a
22a
11a
23a
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13b
3a
3b
12b
21b
31b
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11b
12c
21c
31c
22c
11c
12d
21d
31d
22d
11d
32
40
46
90
70
71
91
50
109
72
104
92
103
73
107
108
301
86
93
74
908
60
62
105
63
31a
58
52
59
51
53
56
55
61
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96
77
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107
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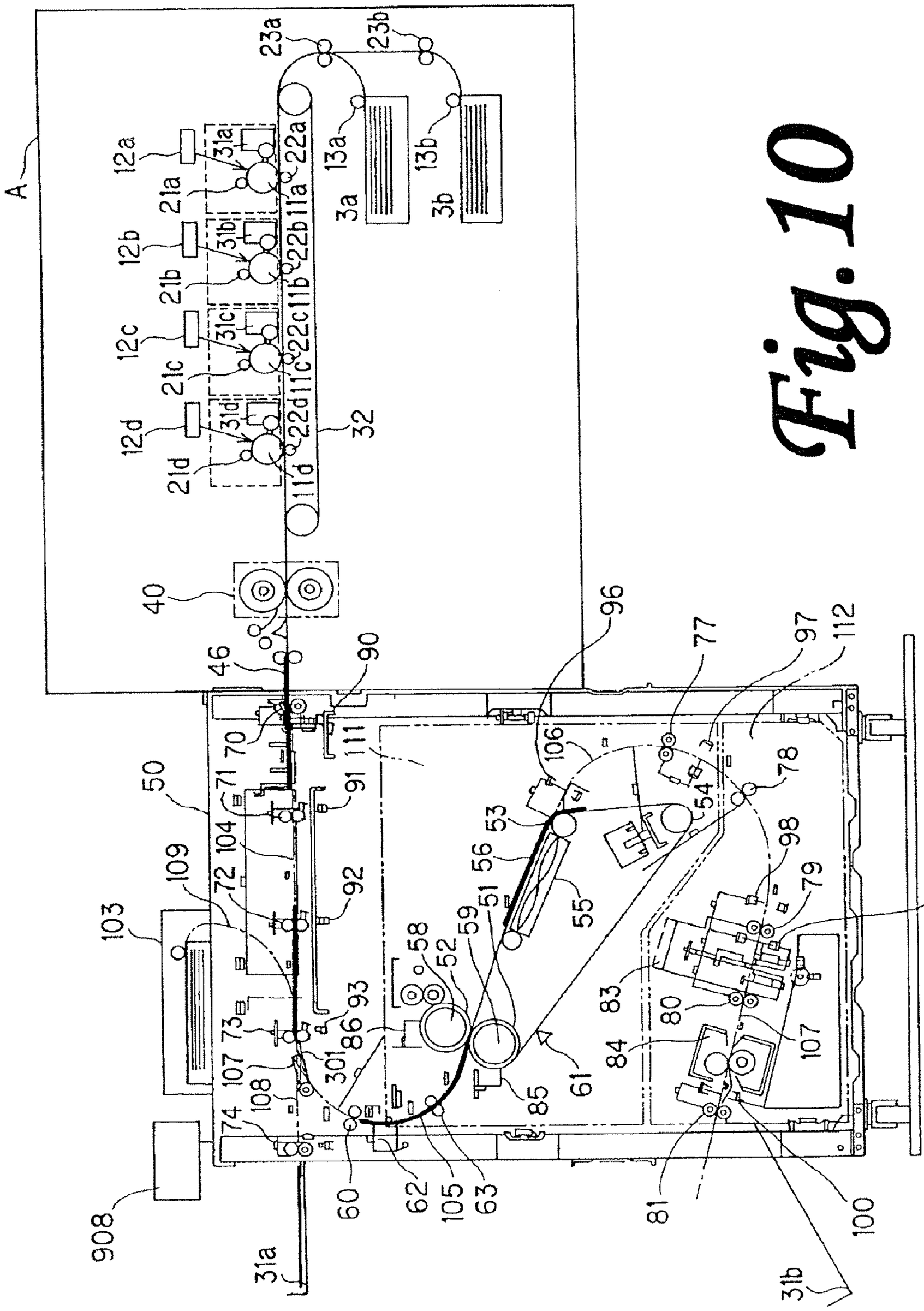
81
100
31b

Fig. 9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13b
3a
3b
12b
21b
31b
22b
11b
12c
21c
31c
22c
11c
12d
21d
31d
22d
11d
32
40
46
90
70
111
91
50
71
104
109
72
92
103
96
77
97
112
106
78
54
53
56
55
98
79
99
58
52
59
51
93
86
73
107
301
108
74
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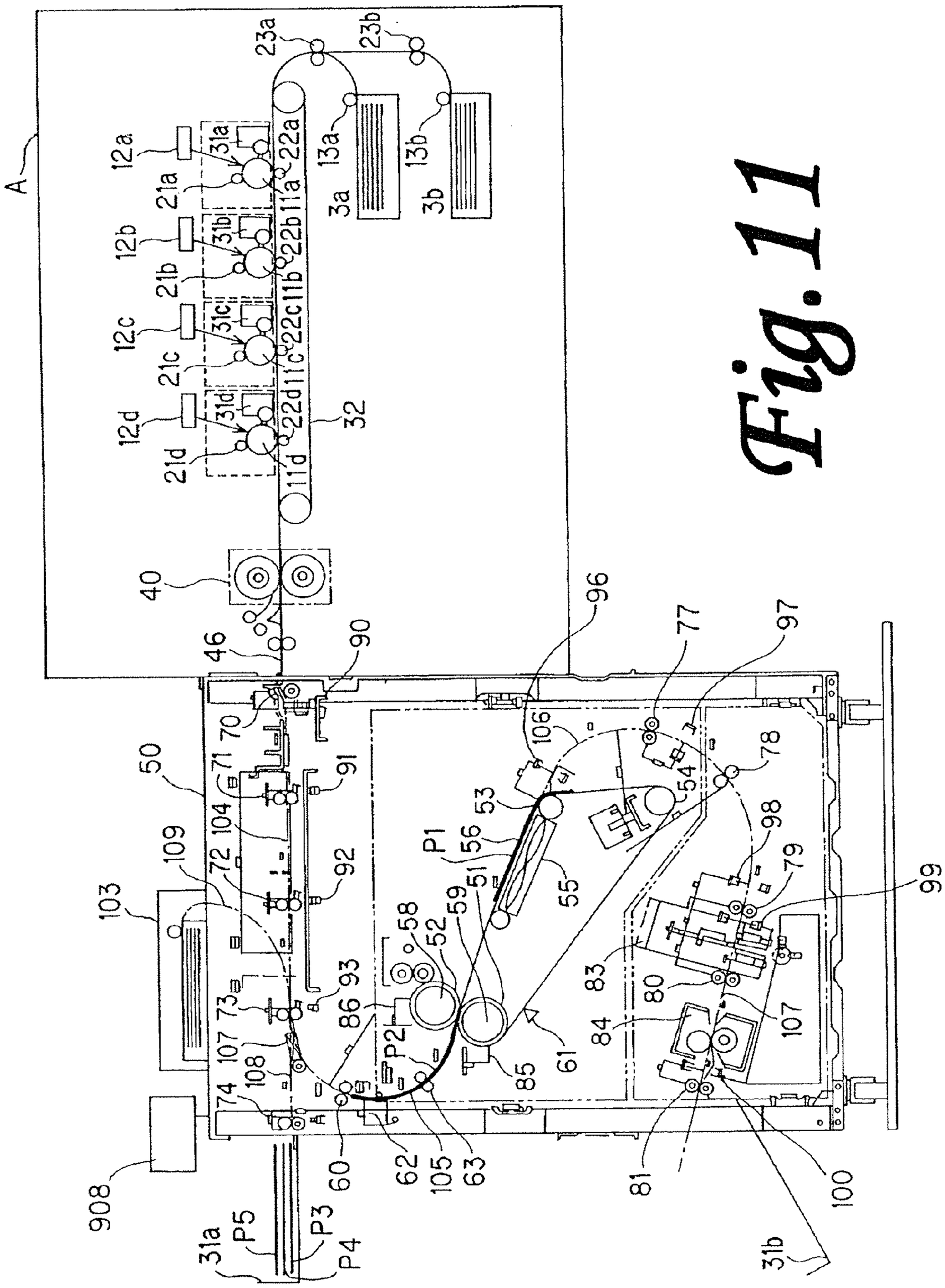
61
83
80
84
107
60
62
105
63
81
100
908
31a
31b

Fig. 10


A
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22a
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13b
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3b
12b
21b
31b
22b
11b
12c
21c
31c
22c
11c
12d
21d
31d
22d
11d
32
40
46
90
96
77
97
70
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71
91
104
53
54
98
109
72
92
P1
56
55
79
99
103
58
52
59
51
83
80
93
86
107
73
P2
84
107
108
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62
105
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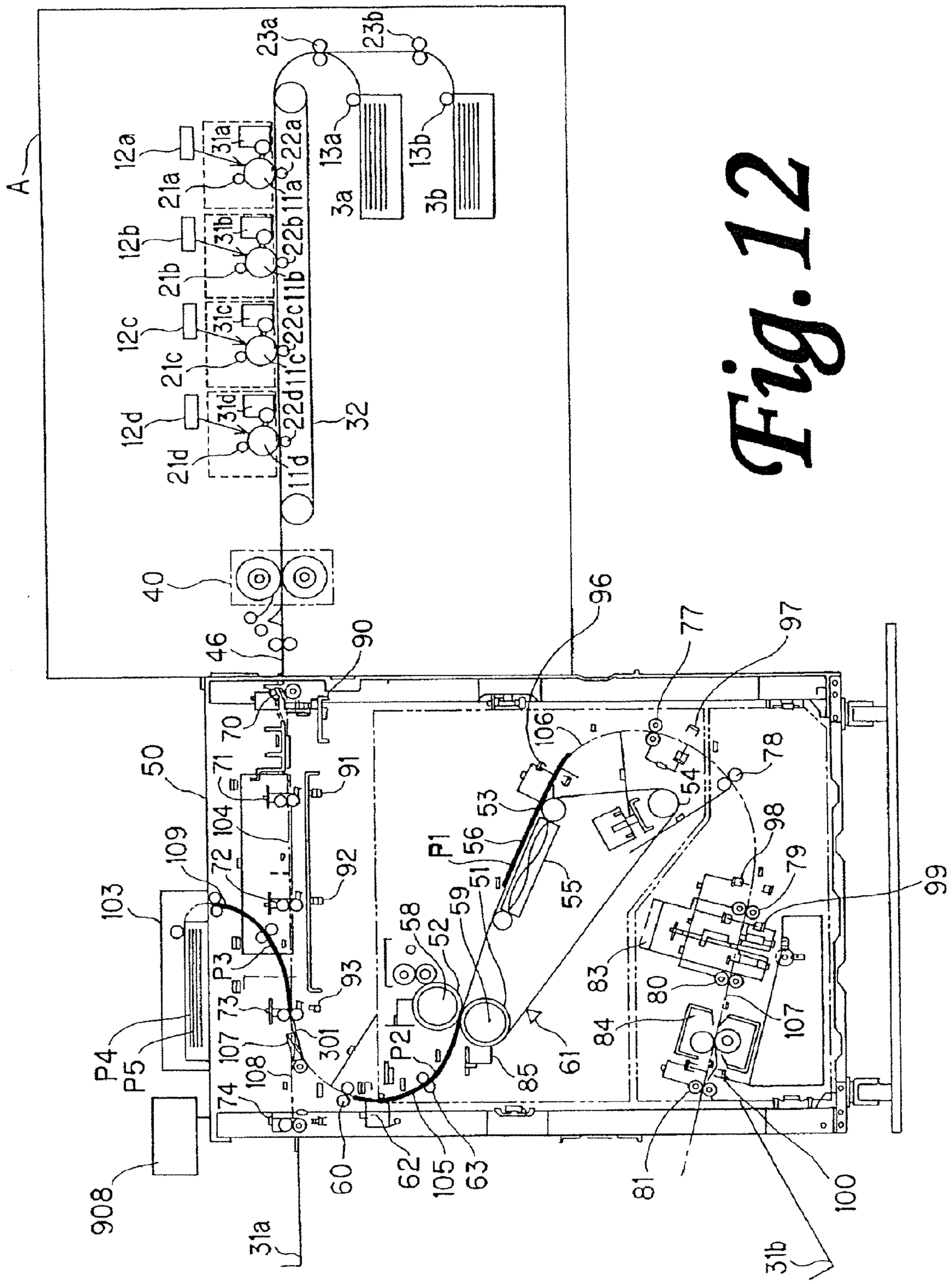
81
100
908
31a
P5
P3
P4
31b

Fig. 11


A
23a
23b
12a
31a
21a
22a
13a
13b
3a
3b
12b
31b
21b
22b
11a
11b
12c
31c
21c
22c
11c
12d
31d
21d
22d
11d
32
40
46
90
96
77
97
70
106
78
50
71
91
53
54
98
109
104
72
92
P1
56
51
55
79
99
103
59
58
52
83
93
P3
80
73
107
301
P2
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P4
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60
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105
63
81
100
908
31a
31b

Fig. 12

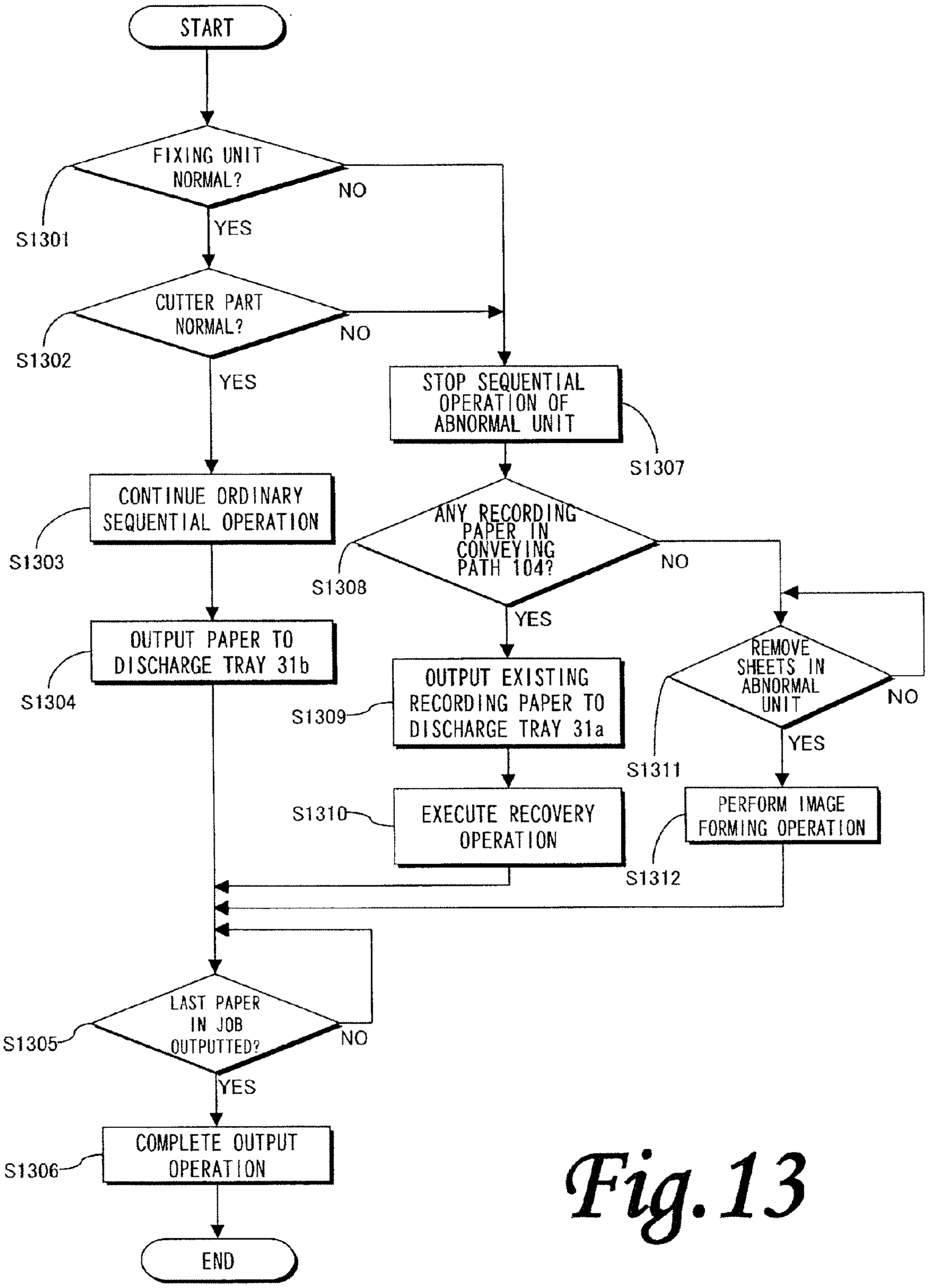

START
FIXING UNIT NORMAL?
NO
YES
S1301
CUTTER PART NORMAL?
NO
YES
S1302
STOP SEQUENTIAL OPERATION OF ABNORMAL UNIT
S1307
CONTINUE ORDINARY SEQUENTIAL OPERATION
S1303
ANY RECORDING PAPER IN CONVEYING PATH 104?
NO
YES
S1308
OUTPUT PAPER TO DISCHARGE TRAY 31b
S1304
OUTPUT EXISTING RECORDING PAPER TO DISCHARGE TRAY 31a
S1309
REMOVE SHEETS IN ABNORMAL UNIT
NO
YES
S1311
EXECUTE RECOVERY OPERATION
S1310
PERFORM IMAGE FORMING OPERATION
S1312
LAST PAPER IN JOB OUTPUTTED?
NO
YES
S1305
COMPLETE OUTPUT OPERATION
S1306
END

Fig. 13

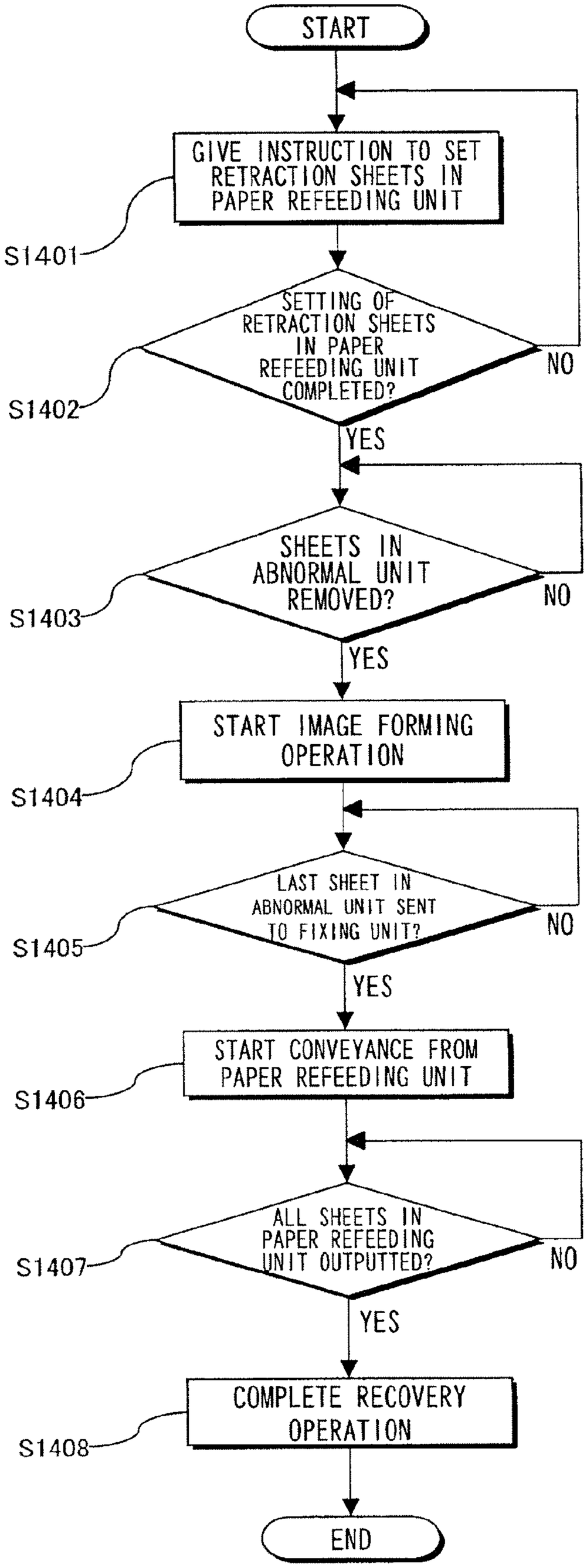
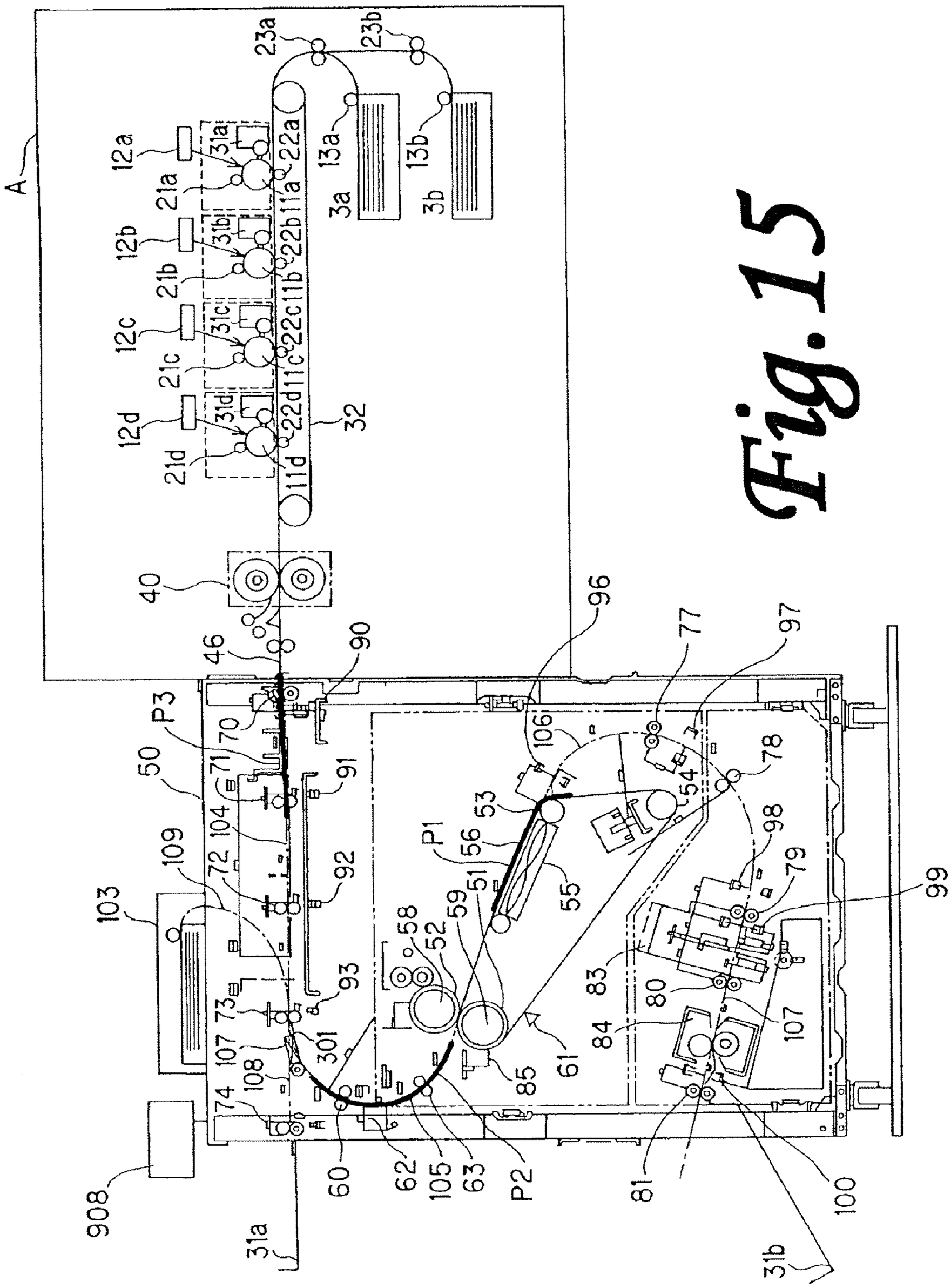

START
GIVE INSTRUCTION TO SET RETRACTION SHEETS IN PAPER REFEEDING UNIT
S1401
SETTING OF RETRACTION SHEETS IN PAPER REFEEDING UNIT COMPLETED?
S1402
NO
YES
SHEETS IN ABNORMAL UNIT REMOVED?
S1403
NO
YES
START IMAGE FORMING OPERATION
S1404
LAST SHEET IN ABNORMAL UNIT SENT TO FIXING UNIT?
S1405
NO
YES
START CONVEYANCE FROM PAPER REFEEDING UNIT
S1406
ALL SHEETS IN PAPER REFEEDING UNIT OUTPUTTED?
S1407
NO
YES
COMPLETE RECOVERY OPERATION
S1408
END

Fig. 14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3b
12b
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31b
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11b
12c
21c
31c
22c
11c
12d
21d
31d
22d
11d
32
40
46
90
96
77
97
P3
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71
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106
78
104
109
72
92
53
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98
P1
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55
79
99
103
51
59
58
52
83
80
93
73
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301
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74
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61
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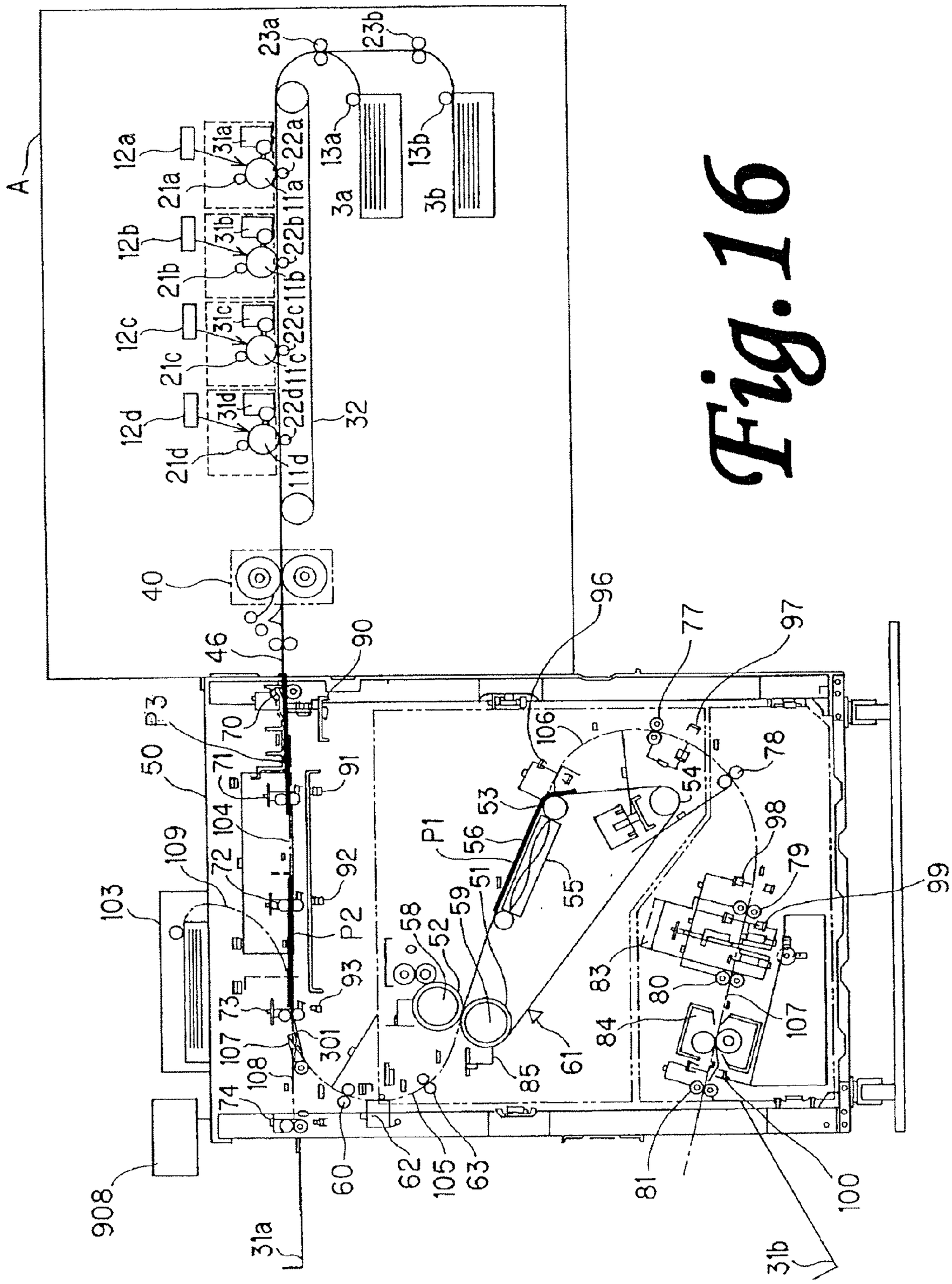
62
105
63
P2
81
100
908
31a
31b

Fig. 15


A
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21a
31a
22a
11a
23a
23b
13a
13b
3a
3b
12b
21b
31b
22b
11b
12c
21c
31c
22c
11c
12d
21d
31d
22d
11d
32
40
46
90
96
77
97
106
78
54
53
P1
56
55
51
59
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52
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80
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107
79
99
98
P3
50
71
70
91
104
72
92
P2
93
73
301
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74
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62
105
63
81
100
103
109
10
908
31a
31b

Fig. 16

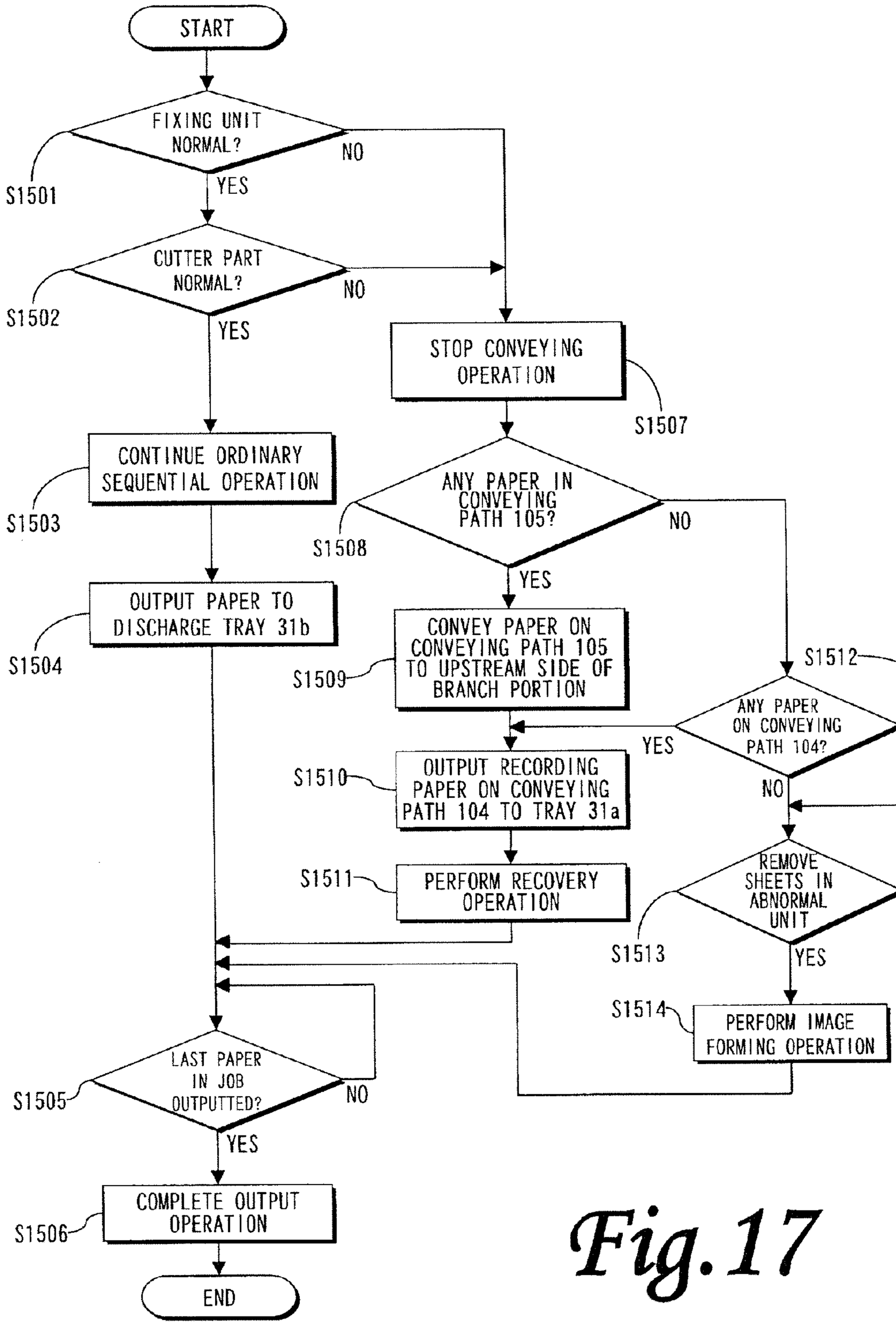
START
FIXING UNIT NORMAL?
NO
YES
S1501
CUTTER PART NORMAL?
NO
YES
S1502
STOP CONVEYING OPERATION
S1507
CONTINUE ORDINARY SEQUENTIAL OPERATION
S1503
ANY PAPER IN CONVEYING PATH 105?
S1508
NO
YES
OUTPUT PAPER TO DISCHARGE TRAY 31b
S1504
CONVEY PAPER ON CONVEYING PATH 105 TO UPSTREAM SIDE OF BRANCH PORTION
S1509
S1512
ANY PAPER ON CONVEYING PATH 104?
YES
NO
OUTPUT RECORDING PAPER ON CONVEYING PATH 104 TO TRAY 31a
S1510
PERFORM RECOVERY OPERATION
S1511
REMOVE SHEETS IN ABNORMAL UNIT
NO
S1513
YES
PERFORM IMAGE FORMING OPERATION
S1514
LAST PAPER IN JOB OUTPUTTED?
S1505
NO
YES
COMPLETE OUTPUT OPERATION
S1506
END

Fig.17

IMAGE FORMING APPARATUS AND SHEET HEATING APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an image forming apparatus and a sheet heating apparatus.

2. Description of the Related Art

In the past, there have been widely known image forming apparatuses using an electrophotographic method, such as copying machines, printers, etc., and there have been commercialized a lot of image forming apparatuses which perform image formation not only in black and white but also in full color.

In addition, requests for the quality of images also become more and more sophisticated in accordance with the increasing use of electrophotographic image forming apparatuses in a variety of fields, too. Here, as one of the factors for determining the image quality, in particular the glossiness of full color images, there is pointed out the smoothness of output images.

In response to such a need, for example, Japanese patent application laid-open No. S64-35452 and Japanese patent application laid-open No. H5-216322 disclose image forming methods, respectively, in which a color toner made of a thermoplastic resin is transferred to a recording material on which a transparent resin layer made of a thermoplastic resin is formed, and then a color image is formed on the recording material by heating and melting the color toner. Additionally, in these image forming methods, a belt fixing unit is proposed as a preferable fixing method.

As such a belt fixing unit, there have been known ones that are described, for example, in Japanese patent application laid-open No H5-216580 and Japanese patent application laid-open No. H4-362679. The belt fixing units as described in these Japanese patent application laid-open Nos. H5-216580 and H4-362679 adopt a construction that a recording material carrying thereon an unfixed toner image is pressed and heated by the fixing belt composed of a heat resisting film, and the toner image is cooled to be solidified while keeping the recording material in intimate contact with the fixing belt, after which the recording material with the toner image fixed thereto is released from the fixing belt.

Accordingly, the toner image and the transparent resin layer on the surface of the recording material with the toner image being fixed while being embedded in the transparent resin layer of the recorder material are solidified along the surface configuration of the belt to provide a smooth entire surface of the recording material. As a result, the color image excellent in luster can be obtained (Japanese patent application laid-open No. 2004-151200 and Japanese patent application laid-open No. 2002-214948).

In addition, as such recording materials each having a resin layer for use with image forming apparatuses, there have been proposed a variety of recording materials, as described in Japanese patent application laid-open No. 2003-84477. In this Japanese patent application laid-open No. 2003-84477, an electrophotographic transfer sheet is proposed which is coated with a resin layer of a thickness of about 10 μm comprising, as a principle component, a thermoplastic resin having a glass-transition temperature of 85 C. or less.

A recording material with a resin layer as referred to above is very expensive in comparison with ordinary plain paper. Accordingly, in case where abnormality occurs in such an apparatus, repeating a copying operation after removal of all

the recording materials in the apparatus as in the past causes a problem that leads to an increase in the running cost thereof.

In addition, in Japanese patent application laid-open No. H9-43912, Japanese patent application laid-open No. H8-272159 and Japanese patent application laid-open No. H11-327220, there have been disclosed apparatuses each including two image forming portions, i.e., a first image forming portion and a second image forming portion that is arranged at a downstream side of the first image forming portion. In particular, Japanese patent application laid-open No. H11-327220 describes that when a jam occurs at any location in either of the downstream second image forming portion and a downstream second fixing unit, a sheet material to be subsequently conveyed is switched into a second conveying path through which it is discharged to a tray that is arranged outside or inside the apparatus.

SUMMARY OF THE INVENTION

The object of the present invention is to provide an image forming apparatus and a sheet heating apparatus which are capable of reducing running costs without performing unnecessary processes on sheets upon occurrence of an abnormality in either of the apparatus or the device.

In order to achieve the above-mentioned object, an image forming apparatus according to one aspect of the present invention includes:

a first heating device which heats a sheet with a toner image formed thereon;

a second heating device which heats said sheet heated by said first heating device;

a first conveying path which conveys said sheet conveyed from said first heating device to said second heating device;

a second conveying path which branches from said first conveying path at a branch portion upstream of said second heating device in said first conveying path for conveyance of said sheet without conveying it to said second heating device;

a discharge tray to which said sheet being conveyed on said second conveying path is discharged;

a feeding portion which feeds sheets put on a paper refeeding tray; and

a feeding conveying path which conveys a sheet fed by said feeding portion to said second heating device, said feeding conveying path having a downstream portion merged into said first conveying path at a location between said first heating device and said second heating device;

wherein when an abnormality factor occurs in said second heating device, a sheet located upstream of said branch portion in said first conveying path is discharged to said discharge tray through said second conveying path; and

an annunciation portion is provided which serves to inform that said sheet discharged to said discharge tray should be set in said refeeding tray when said sheet has been discharged to the discharge tray upon occurrence of the abnormality factor in said second heating device.

In addition, an image forming apparatus according to another aspect of the present invention includes:

a first heating device which heats a sheet with a toner image formed thereon;

a second heating device which heats said sheet heated by said first heating device;

a first conveying path which conveys said sheet conveyed from said first heating device to said second heating device;

a second conveying path which branches from said first conveying path at a branch portion upstream of said second heating device in said first conveying path for discharging said sheet without conveying it to said second heating device;

a discharge tray to which said sheet being conveyed on said second conveying path is discharged;

a feeding portion which feeds sheets put on a paper refeeding tray; and

a feeding conveying path which conveys a sheet fed by said feeding portion to said second heating device, said feeding conveying path having a downstream portion merged into said first conveying path at a location between said first heating device and said second heating device;

wherein when abnormality factor occurs in said second heating device, a sheet existing between said branch portion and said second heating device in said first conveying path is conveyed upstream of said branch portion, and the sheet thus conveyed upstream of said branch portion is discharged onto said discharge tray through said second conveying path.

Moreover, a sheet heating apparatus according to a further aspect of the present invention includes:

a first conveying path which conveys a sheet being conveyed from an image forming apparatus main body that includes an image forming portion for forming a toner image on said sheet and a heating device for heating said sheet having said toner image formed thereon by means of said image forming portion;

a second heating device which heats said sheet being conveyed on said first conveying path;

a second conveying path which branches from said first conveying path at a branch portion upstream of said second heating device in said first conveying path for discharging said sheet without conveying it to said second heating device;

a discharge tray to which said sheet being conveyed on said second conveying path is discharged;

a feeding potion which feeds sheets put on a paper refeeding tray; and

a feeding conveying path which conveys a sheet fed by said feeding portion to said second heating device, said feeding conveying path having a downstream portion merged into said first conveying path at a location between said first heating device and said second heating device;

wherein when an abnormality factor occurs in said second heating device, a sheet located upstream of said branch portion is discharged onto said discharge tray through said second conveying path; and

after the abnormality factor in said second heating device is removed and the sheet discharged to said discharge tray through said second conveying path is set in said paper refeeding tray, said sheet feeding portion feeds the sheet set in said paper refeeding tray to said second heating device.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a cross sectional view showing the construction of an image forming apparatus according to a first embodiment of the present invention;

FIG. **2** is a cross sectional view showing the construction of a fixing device according to the first embodiment of the present invention;

FIG. **3** is a block diagram showing the construction of a controller that controls the fixing device in the image forming apparatus;

FIG. **4**A is a view showing the state of a toner on a recording material after passage of a first fixing unit in the image forming apparatus;

FIG. **4**B is a view showing the state of the toner on the recording material after passage of a second fixing unit in the image forming apparatus;

FIG. **5** is a view showing the timing at which the recording material is adhered to a fixing belt according the first embodiment of the present invention;

FIG. **6** is a view showing the conveyance sequence of the recording material at a normal time in the image forming apparatus according to the first embodiment of the present invention;

FIG. **7** is a view showing the conveyance sequence of the recording material at the normal time in the image forming apparatus according to the first embodiment of the present invention;

FIG. **8** is a view showing the conveyance sequence of the recording material at the normal time in the image forming apparatus according to the first embodiment of the present invention;

FIG. **9** is a view showing the conveyance sequence of the recording material at an abnormal time in the image forming apparatus according to the first embodiment of the present invention;

FIG. **10** is a view showing the conveyance sequence of the recording material at the abnormal time in the image forming apparatus according to the first embodiment of the present invention;

FIG. **11** is a view showing the conveyance sequence of the recording material at the abnormal time in the image forming apparatus according to the first embodiment of the present invention;

FIG. **12** is a view showing the conveyance sequence of the recording material at the time of recovery in the image forming apparatus according to the first embodiment of the present invention;

FIG. **13** is a flow chart showing a series of continuous operations of the image forming apparatus according to the first embodiment of the present invention at the abnormal time;

FIG. **14** is a flow chart showing a series of recovery operations of the image forming apparatus according to the first embodiment of the present invention at the abnormal time;

FIG. **15** is a view showing the conveyance sequence of a recording material at a normal time in an image forming apparatus according to a second embodiment of the present invention;

FIG. **16** is a view showing the conveyance sequence of the recording material at the normal time in the image forming apparatus according to the second embodiment of the present invention; and

FIG. **17** is a flow chart showing a series of continuous operations of the image forming apparatus according to the second embodiment of the present invention at an abnormal time.

DESCRIPTION OF THE EMBODIMENTS

Hereinafter, preferred embodiments of the present invention will be described in detail while referring to the accompanying drawings. In all the figures of the following embodiments, the same symbols are attached to the same or corresponding portions or elements.

In FIG. **1**, there is shown an image forming apparatus that is provided with a fixing device (sheet heating apparatus).

A main body A of the image forming apparatus is a color recording device of a tandem type for transferring a toner image onto a recording material P in the form of a sheet. The image forming apparatus main body A transfers the toner image to the recording material in the form of recording paper P at respective color stations in a sequential manner thereby to form a colored toner image on a recording paper. That is, as an image forming portion, there are provided four transfer units that form four colors comprising black BK, cyan C, magenta M and yellow Y, respectively, on the recording paper P. These transfer units are constructed in such a manner that it includes photosensitive drums **11***a* through **11***d*, exposure devices **12***a* through **12***d*, chargers **21***a* through **21***d*, development units **31***a* through **31***d*, and transfer rollers **22***a* through **22***d*, respectively. In addition, pieces of recording paper P on which an image is to be formed are loaded and received in cassettes **3***a*, **3***b*, carried out by pickup rollers **13***a*, **13***b*, and conveyed onto an endless belt **32** by conveyance rollers **29***a*, **23***b*.

Also, a piece of recording paper P is heated by a first heating device in the form of a fixing unit **40**, whereby the toner image formed on the recording paper P is fixed to the recording paper P. In the image forming apparatus, a mode A (plain paper recording mode) and a mode B (photograph mode) can be selectively set as a setting.

(Mode A (Plain Paper Recording Mode))

In the node A, a recording paper P**1** (e.g., plain paper of 81 g/m^3) provided in a sheet feeder is fed from the sheet feeder, and a toner image is transferred to the recording paper P**1** and fixed thereto by heating the sheet or recording material by means of the first heating device in the form of the fixing unit **40**. Thereafter, the recording material P with the toner image fixed thereto is conveyed to a sheet heating apparatus in the form of a fixing unit **50** while passing through a conveying path **46**. Also, the recording paper P is driven to successively pass through a common path in the form of a conveying path **104** by means of conveyance roller pairs **70**, **71**, **72**, **73**. The recording paper P after passage through the common path is switched by a switching portion in the form of a flapper **107**, so that it is conveyed through a second conveying path in the form of a discharging conveying path **108**, and discharged to a discharge tray **31***a* by means of a discharge roller pair **74**.

(Mode B (Photograph Mode))

On the other hand, in the mode B, a recording paper P provided in the sheet feeder is supplied and a toner image is transferred thereto. Thereafter, the sheet or recording material P is passed through the fixing unit **40**, and then conveyed to the fixing unit **50** while passing through the conveying path **46**. The recording paper P successively is passed through the conveying path **104** by means of the conveyance rollers **70**, **71**, **72**, **73**, and is conveyed, by switching of the flapper **107**, to a conveying path **105** which constitutes a part of the first conveying path. Thereafter, a fixing process is performed by a fixing belt **56** which constitutes a part of a second heating device. Subsequently, the recording material P passes through the conveying path **106** as a part of the first conveying path, so that predetermined processes are successively carried out on the recording material P by means of cutters **83**, **84**, and the recording material P thus processed is discharged to a discharge tray **31***b*.

In addition, the fixing unit **50**, which constitutes the sheet heating apparatus according to the first embodiment of the present invention, is shown in FIG. **2**. The fixing unit **50** is a device that reheats a sheet heated by the fixing unit **40** of the image forming apparatus main body A and then cools it to give luster to an image on the sheet. As already stated, the fixing unit **50** is provided with the conveying path **104** on which the sheet having passed the conveying path **46** of the image forming apparatus is conveyed. The conveyance rollers **71**, **72**, **73** are arranged on the conveying path **104** which is connected at its downstream side with a conveying path **105**. A pair of conveyance rollers **60** and a pair of registration rollers **63** are arranged on the conveying path **105**. Conveyance roller pairs **77**, **78** are arranged on the conveying path **106** at locations downstream of the fixing belt **56**. The conveying path **106** is connected at its downstream side with a cutting conveying path **107**, on which are arranged conveyance roller pairs **79**, **80** and a discharge roller pair **81**.

Optical sensors **90**, **91**, **92**, **62**, **96**, **97**, **98**, **99**, **100** are arranged in the conveying paths **104**, **105**, **106**, **107** in this order from an upstream side to a downstream side thereof. The optical sensors **90**, **91**, **92**, **93**, **62**, **96**, **97**, **98**, **99**, **100** are sensors that serve to detect the presence or absence of a recording paper in the conveying paths **104**, **105**, **106**, **107**. The optical sensors **90**, **91**, **92**, **93**, **62**, **96**, **97**, **98**, **99**, **100** are used for controlling the conveyance and stopping of the recording paper, as well as for detecting whether there is abnormality in the conveyance of the recording paper.

A branch portion **301** is arranged at a boundary between the conveying path **104** and the conveying path **105**. At the branch portion **301**, the second conveying path in the form of the discharging conveying path **108** branches from the first conveying path including the conveying path **104** and the conveying path **106**. The discharging conveying path **108** is a conveying path that serves to discharge a sheet or recording material onto the discharge tray **31***a* arranged outside the apparatus. The flapper **107**, being free to swing, is arranged at the branch portion **301**.

The fixing unit **50** is provided with a sheet feeding portion in the form of a paper refeeding unit **103**, on which the sheet discharged to the discharge tray **31***a* is put again. The paper refeeding unit **103** is a device that serves to feed the sheet thus put thereon to the conveying path **104**, i.e., to the later-mentioned second heating device. The paper refeeding unit **103** is provided with a paper refeeding tray **103***a*. The sheet fed by the paper refeeding unit **103** is conveyed on the feeding conveying path **109**, which merges into the conveying path **104** at a location upstream of the second heating device. That is, the feeding conveying path **109** is connected at its downstream side with the conveying path **104**.

As shown in FIG. **2**, the fixing unit **50** according to this first embodiment is constructed in such a manner that it includes a fixing roller **51**, a pressure roller **52**, a rotating roller **53** and a tension roller **54** which together constitute the second heating device, a cooling portion in the form of a cooling fan **55**, and an endless belt in the form of a fixing belt **56** wrapped around these rollers and the belt. Further, provision is made for a sensor **61** that detects the position of a recording paper P on the fixing belt **56**, a registration sensor **62** that detects the leading end of the recording paper P, and a pair of registration rollers **63**.

Roller heating heaters **59**, **58**, each of which constitutes a heating portion, are arranged in the fixing roller **51** and the pressure roller **52**, respectively. In these roller heating heaters **58**, **59**, thermal management is carried out by means of temperature sensors **85**, **86** each comprising a thermistor for example.

The fixing roller **51** has a concentric three-layer structure including a core portion, an elastic layer, and a mold release

layer. The core portion of the fixing roller **51** is formed of a hollow aluminum pipe of 44 mm in diameter and 5 mm in thickness. In addition, a heat source in the form of a halogen lamp is arranged in the hollow pipe of the core portion. The elastic layer is made of silicone rubber of 50 degrees in JIS A hardness and 3 mm in thickness. The mold release layer is made of PFA of 50 μm in thickness. Also, a similar construction is adopted in the pressure roller **52**.

In addition, the fixing belt **56** is constructed in a two-layer structure comprising a mold release layer like a mirror finished surface formed on a surface (front surface) which is in abutment with the recording paper P and the pressure roller **52**, and a base layer or member formed on a surface (rear surface) which is in abutment with the fixing roller **51**. The mold release layer is made of PFA of 10 μm in thickness, and the base layer is formed of a belt comprising a stainless sheet of 100 μm in thickness with its opposite ends being connected with each other in an endless manner.

The cooling fan **55** is arranged at an inner side of the fixing belt **56** for blowing air flow in a direction orthogonal to the plane of a sheet. The cooling fan **55** cools the recording paper that is conveyed by the fixing belt **56** and heated by the roller heating heaters **59**, **58**.

A predetermined tension is provided to the fixing belt **56** by means of the tension roller **54** so that the fixing roller **51** is driven to rotate in a right rotational direction in FIG. **2**, whereby the fixing belt **56** is rotated. As a result, the curvature of the fixing belt **56** in the cooling portion is held at a substantially prescribed curvature by the rigidity of the fixing belt **56** itself.

In addition, electric power is supplied to the roller heating heaters **58**, **59** comprising the halogen lamps arranged in the fixing roller **51** and the pressure roller **52**, respectively, whereby the surface temperatures of the fixing roller **51** and the pressure roller **52** are raised.

Now, the construction of the recording paper P will be described. Specifically, the recording paper used in this first embodiment is constructed to include a base material or substrate having a pigment coated layer formed on a least one surface thereof, and a resin layer formed on the pigment coated layer. The pigment coated layer is composed of a bonding material and pigments as its principal components, and the resin layer is composed of a thermoplastic resin as its principal component.

Though the resin layer contains the thermoplastic resin and a thermosetting resin as its principal components, it may be a mixed resin layer comprising a thermoplastic resin and a thermosetting resin mixed with each other. Also, the resin layer can be formed of a plurality of layers including a thermoplastic resin layer composed of a thermoplastic resin as its principal component and a thermosetting resin layer composed of a thermosetting resin as its principal component.

In case where the resin layer is formed of the plurality of layers, it is preferable that the thermosetting resin layer composed of the thermosetting resin as its principal component be arranged as a top or uppermost layer. Further, the resin layer can also be of a layer construction comprising these mixed resin layer, thermoplastic resin layer and thermosetting resin layer combined with one another. In this case, it is preferable that the top or upper most layer be a layer including a thermosetting resin such as a mixed resin layer, a thermosetting resin layer, or the like. A polyester resin, a styrene acrylic ester, a styrene methacrylic acid ester, or the like, can be used as the thermoplastic resin, but in particular, it is preferable to use a polyester resin.

The cutters **83**, **84** for cutting out the recording paper conveyed on the cutting conveying path **107** are arranged at locations downstream of the fixing belt **56**.

The fixing unit **50** is provided with a display device **908** for informing a user of operations of the apparatus.

(Control of the Fixing Unit)

Next, reference will be made to the control of the fixing unit according to the first embodiment of the present invention. In FIG. **3**, there is shown a block diagram of performing the control of the fixing unit **50** according to this first embodiment. In FIG. **3**, a CPU **401** is a processing circuit for executing mechanical control on the fixing unit **50**, and performs a control operation according to programs stored in a ROM **402**. A RAM **403** is a rewritable storage portion that is used by the CPU **401**. A variety of kinds of sensors **406** generate output signals which are read into the CPU **401** through an I/O port **404**. The variety of kinds of sensors **406** also include the optical sensors **90**, **91**, **92**, **93**, **62**, **96**, **97**, **98**, **99**, **100** that detect the presence or absence of a recording paper, and a presence or absence detecting sensor **103***b*.

The optical sensors **62**, **90** through **93** and **96** through **100** are sensors that serve to detect whether there is a recording paper at individual locations in the conveying path along which the optical sensors are arranged. The signals from the optical sensors **62**, **90** through **93** and **96** through **100** are transmitted to the CPU **4 1** through the I/O port **404**. For example, the CPU **401** monitors, based on the signals from these optical sensors **62**, **90** through **93** and **96** through **100**, whether an interval or timing from a leading end to a trailing end of the recording paper is within a certain predetermined interval. In other words, the CPU **401** detects, based on the signals from the optical sensors **62**, **90** through **93** and **96** through **100**, that an abnormality in the conveyance of the recording paper has occurred.

For example, in case where after detection of the passage of the recording paper by a certain optical sensor, another optical sensor immediately downstream of the preceding optical sensor does not detect the leading end of the recording paper within a predetermined time, the CPU **401** determines that a delay jam has occurred. Here, note that similarly, in case where a recording paper P remains in the conveying paths **104**, **105**, **106** of the fixing unit when the power is turned on in the fixing unit, such an event is detected by the optical sensors **62**, **90** through **93** and **96** through **100**, and the CPU **401** determines that the fixing unit is abnormal.

In addition, when the recording paper detecting time by these optical sensors **62**, **90** through **93** and **96** through **100** for detecting the recording paper P is longer than the predetermined time, the CPU **401** determines that a stay jam has occurred.

The I/O port **404** is connected to a driver **405**. An output from the I/O port **404** is converted into a necessary drive voltage and supplied to a variety of kinds of loads **407**. Each of the loads **407** includes a paper feed motor for driving the fixing heater and the conveyance rollers and a motor, a clutch, a solenoid and so on for cutting out the recording paper P. The loads **407** also include a solenoid that operates the flapper **107**. The I/O port **404** is connected to the display device **908**. The CPU **401** can control the display of the display device **908**. A serial communication interface (SCI) **409** is an interface that serves to send and receive information between the CPU **401** and a control portion of the image forming apparatus. The control portion of the image forming apparatus is a controller that serves to control the image forming apparatus main body A.

Further, the temperature sensors **85**, **86** (see FIG. **1** and FIG. **2**) for detecting the temperatures of the fixing roller **51** and the pressure roller **52**, respectively, in the fixing unit **50**

are connected to an A/D input of the CPU **401**. The CPU **401** controls the fixing heater in accordance with the detected temperature data from the temperature sensors **85**, **86** connected to the A/D input.

(Image Forming Operation)

Next, reference will be made to the image forming operation of the fixing unit according to this first embodiment of the present invention.

First of all, a recording paper P output from the image forming apparatus main body A is conveyed to the fixing unit **50** wherein the recording material P is driven to successively pass through the conveying path **104** by means of conveyance rollers **70**, **71**, **72**, **73**. The recording paper P thus having passed through the conveying path **104** is guided to the conveying path **105** by the flapper **107**, and is conveyed in the conveying path **105**. Thereafter, the recording paper P passes the registration sensor **62**, which is an optical sensor, and is stopped temporarily at the time when the leading end thereof is clamped by the registration roller pair **63**. Here, note that at this time, the rotation of the fixing belt **56** is continued.

A desired position of the fixing belt **56** is detected by the sensor **61**, and the registration roller pair **63** are started to rotate again in such a manner that the timing at which a recording paper adhering position HT on the fixing belt **56** arrives at a nip portion of the fixing belt **56** between the fixing roller **51** and the pressure roller **52** and the timing at which the leading end of the recording paper P arrives at a fixing nip portion are synchronized with each other. As the registration roller pair **63** starts rotating, the leading end of the recording paper P is sent to the fixing nip (a nip point between the fixing belt **56** and the pressure roller **52**).

Thereafter, the recording paper P passes through the pressure contact portions of the fixing belt **56** and the pressure roller **52**. In this case, heat from the fixing roller **51** and the pressure roller **52** is applied to the recording paper P and a toner T on the recording paper P. Accordingly, the temperature of a transparent resin layer P**2** in the recording paper P rises to soften the transparent resin layer P**2**, and the pressure by the fixing roller **51** and the pressure roller **52** is applied to the recording paper P. As a result, the toner image, which is in a state shown in FIG. **4**A before passing through the pressure contact portions, is embedded into the transparent resin layer P**2** of a high temperature on the recording paper P, as shown in FIG. **4**B. At the same time, the recording paper P is placed into intimate contact with the surface of the fixing belt **56**.

Thereafter, the recording paper P is conveyed to a cooling area in accordance with the rotation of the fixing belt **56** while being kept in intimate contact with the fixing belt **56**. In the cooling area, the recording paper P is forcedly cooled in an efficient manner under the action of the cooling fan **55** and an airflow flowing in an air duct enclosing the cooling fan **55**.

The recording paper P being placed in intimate contact with the surface of the fixing belt **56** is cooled in the cooling area, and as shown in FIG. **5**, at a location at which the curvature of the fixing belt **56** is changed by the rotating roller **53**, the recording paper P begins to peel off or separate, at its leading end, from the surface of the fixing belt **56** under the action of the rigidity of the recording paper P itself. In FIG. **5**, the recording paper P is peeled or separated from a position HT in the rotating roller **53** and the fixing belt **56**.

Then, as shown in FIG. **1**, the recording paper P thus peeled or separated passes through the conveying path **106** and is cut out by the cutters **83**, **84**. Here, note that the recording paper P is cut at its upper and lower ends and at its right and left sides with a cutting length WT and a cutting width WY being shorter than the length and width of a margin area. Thereafter, the recording paper P is carried out to the discharge tray **31***b*.

(Image Forming Operation)

Next, reference will be made to a series of continuous operations of the image forming apparatus according to this first embodiment at a normal time thereof. Here, an exemplary case will be described in which an image is continuously output in five sheets of paper in a photograph mode. In FIG. **6**, there is shown the state of conveyance of the recording paper P in the image forming apparatus according to this first embodiment.

As shown in FIG. **6**, a first sheet P**1** on which an image is formed by the image forming apparatus main body A is temporarily stopped based on the detection of its leading end by the registration sensor **62**, which is an optical sensor, after having passed through the conveying paths **104**, **105** according to a predetermined sheet conveyance sequence. At this time, a second sheet P**2** is stopped at a location at which it is clamped by the conveyance rollers **72** based on the detection thereof by the optical sensor **92**.

At this time, a third sheet P**3** passes through the fixing unit **40** of the image forming apparatus main body A. Further, an image forming operation for a fourth sheet P**4** is executed on the transfer belt, and a fifth sheet P**5** is at a position fed from the sheet feeding portion. A desired position of the first sheet P**1** on the fixing belt is detected by the sensor **61**, and the registration roller pair **63** are restarted to rotate in such a manner that the timing at which the recording paper adhering position HT on the fixing belt **56** arrives at the nip portion of the fixing belt **56** between the fixing roller **51** and the pressure roller **52** and the timing at which the leading end of the first sheet P**1** arrives at the fixing nip portion are synchronized with each other, whereby the first sheet P**1** is conveyed into the fixing nip.

Thereafter, the first sheet P**1** passes through the pressure contact portions of the fixing belt **56** and the pressure roller **52**. In this case, the first sheet P**1** and a toner T on the first sheet P**1** are heated by the fixing roller **51** and the pressure roller **52**, whereby the temperature of the transparent resin layer P**2** in the first sheet P**1** is raised to soften the transparent resin layer P**2**, and the pressure between the fixing roller **51** and the pressure roller **52** is applied to the first sheet P**1**. As a result, the toner image, which is in the state shown in FIG. **4**A before passing through the pressure contact portions, is embedded into the transparent resin layer P**2** of a high temperature on the first sheet P**1**, as shown in FIG. **4**B. At the same time, the first sheet P**1** is placed into intimate contact with the surface of the fixing belt **56**.

Thereafter, the first sheet P**1** is conveyed to a cooling area in accordance with the rotation of the fixing belt **56** while being kept in intimate contact with the fixing belt **56**. In the cooling area, the first sheet P**1** is forcedly cooled in an efficient manner under the action of the cooling fan **55** and the airflow flowing in then air duct enclosing the cooling fan **55**. Here, note that this cooling fan **55** is constructed so as to be able to change the flow rate of the airflow. As a result, the flow rate of the airflow can be set in such a manner that the recording paper P on the fixing belt **56** can be easily separated therefrom.

In this manner, the first sheet P**1** being placed in intimate contact with the surface of the fixing belt **56** is cooled in the cooling area to a sufficient extent, and is peeled off or separated, under the action of the rigidity of the first sheet P**1**, from the surface of the fixing belt **56** in an area in which the curvature of the fixing belt **56** is changed by the rotating roller **53**.

In addition, as shown in FIG. **5** and FIG. **6**, the first sheet P**1** being conveyed while placed in intimate contact with the surface of the fixing belt **56** is started to peel off or separate therefrom at its leading end under the action of the rigidity of the first sheet P**1** itself at the time when it arrives at the position HT.

Here, note that the first sheet P**1** thus separated passes the optical sensor **97** through the conveying path **106**, as shown in FIG. **7**. At this time, the second sheet P**2** is conveyed on the

fixing belt **56**, in the course of which the toner image formed on the surface of the second sheet P**2** is embedded into the resin layer. With the toner image being embedded into the resin layer, luster is given to the image of the recording paper. Also, the third sheet P**3** is temporarily stopped by being detected by the registration sensor **62**. The fourth sheet P**4** is stopped, upon detection thereof by the sensor **92**, at a location at which it is clamped by the conveyance rollers **72**, and the fifth sheet P**5** passes through the fixing unit **40** of the image forming apparatus main body A.

Thereafter, as shown in FIG. **8**, the first sheet P**1** is conveyed up to the sensor **98** arranged immediately before the cutter **83**, where it is temporarily stopped by being clamped by the conveyance rollers **79**. At this time, the second sheet P**2** passes through he conveying path **106** while being peeled or separated from the fixing belt **56**. Also, the third sheet P**3** is conveyed on the fixing belt **56** at predetermined timing, in the course of which a toner image is embedded into a resin layer thereof, as in the first sheet P**1** and the second sheet P**2** preceding thereto. The fourth sheet P**4** passes through the flapper **107**, and the fifth sheet P**5** passes through the conveying path **104**.

Subsequently, the first sheet P**1** is conveyed to the cutter registration sensor **99** in the form of an optical sensor, and is cut out by the cutters **83**, **84** based on a predetermined sequence. Here, the first sheet P**1** is cut out at its upper (leading) and lower (trailing) ends and at its right and left (lateral) sides with a cutting length WT and a cutting width WY, respectively, that are shorter than the lengths and widths of margin areas of the first sheet P**1**, and is then carried out to the discharge tray **31***b*. The following second through fifth sheets P**2** through P**5** are similarly subjected to cutting processing, as in the first sheet P**1**, and is then carried out to the discharge tray **31***b*.

(Outline of the Operation at Abnormal Time)

Next, reference will be made to the outline of a series of continuous operations of the image forming apparatus according to this first embodiment at an abnormal time. Here, an exemplary case will be described in which an image is continuously output in five sheets of paper in a photograph mode.

As shown in FIG. **9**, a first sheet P**1** on which an image is formed by the image forming apparatus main body A is conveyed on the fixing belt **56** through the conveying paths **104**, **105** according to a predetermined sheet conveyance sequence.

Thereafter, when the first sheet P**1** is not peeled or separated from the fixing belt **56** and such a state of the non-separation of the first sheet P**1** is detected by the separation sensor **96** in the form of an optical sensor, the conveyance of the first sheet P**1** and a second sheet P**2** in the fixing unit **50** are stopped, and a temperature adjusting operation is stopped in response to the stopping of the conveyance of the first sheet P**1** and the second sheet P**2**. In addition, at this time, the flapper **107** is switched over. In other words, the flapper **107** is controlled by the CPU **401** so as to be swung to a position to guide a recording paper to the discharging conveying path **108**. Accordingly, the third sheet P**3** existing on the conveying path **104** at a location upstream of the branch portion **301** is guided to the discharging conveying path **108**.

In other words, when the CPU **401** determines based on the output of the separation sensor **96** that abnormality occurred in the second heating device, the CPU **401** controls the driving of the fixing belt **56** and the pressure roller **52** so as to stop the conveyance of the recording paper downstream of the branch portion. Further, when the CPU **401** determines based on the output of the separation sensor **96** that abnormality occurred in the second heating device, the CPU **401** controls the flapper **107** to swing downwardly so as to discharge the recording paper upstream of the branch portion **301** to the outside of the apparatus through the discharging conveying path **108**, and at the same time controls the conveyance rollers **70**, **71**, **72**, **73**, **74** to discharge the recording paper upstream of the branch portion **301** through the discharging conveying path **108**.

According to the above operations, the third sheet P**3** is discharged to the discharge tray **31***a*, as shown in FIG. **10**. In addition, processing similar to the processing performed on the third sheet P**3** is carried out on the following fourth and fifth sheets P**4**, P**5** that exist upstream of the third sheet P**3**. In other words, the following fourth and fifth sheets P**4**, P**5** are also discharged to the outside of the apparatus through the discharging conveying path **108**. As a result, the third sheet P**3** through the fifth sheet P**5** are discharged onto the discharge tray **31***a*, as shown in FIG. **11**.

(Outline of Recovery Operation)

Next, reference will be made to the outline of a series of recovery operations according to this image forming apparatus. First of all, the third sheet P**3**, the fourth sheet P**4**, and the fifth sheet P**5** are discharged to the discharge tray **31***a* in accordance with the occurrence of an abnormality of the image forming process in the image forming apparatus according to this first embodiment. The user is prompted by the display device **908** to set the third sheet P**3**, the fourth sheet P**4** and the fifth sheet P**5** discharged to the discharge tray **31***a* onto the paper refeeding tray **103***a*, whereby these sheets P**3** through P**5** are sequentially loaded or stacked one over another on the paper refeeding tray **103***a* of the paper refeeding unit **103** by the user with their toner image forming surfaces being directed downwardly.

In addition, when an information signal indicating that the setting of the third sheet P**3**, the fourth sheet P**4** and the fifth sheet P**5** in the paper refeeding unit **103** has been completed is supplied to the control portion of the image forming apparatus (see FIG. **3**), a series of recovery operations are executed. In the recovery operations, the image forming operation is executed in succession based on a predetermined sequence.

First of all, the image forming apparatus main body A freshly performs image formation by using new pieces of recording paper P as a first sheet P**1** and a second sheet P**2**. The first sheet P**1** and the second sheet P**2** with images formed thereon are conveyed to the fixing unit **50**, as shown in FIG. **12**, and similar processes as those at the time of normal operation are executed thereon. In another words, the images on the sheets are heated by the fixing belt while passing the conveying paths **104**, **105**, **106**, respectively, of the fixing unit **50**. Here, the conveyance of the third sheet P**3** is performed through the feeding conveying path **109** at the timing at which the second sheet P**2** is conveyed to the fixing belt **56**, and similarly in the fourth sheet P**4** and the firth sheet P**5**, the supply of the sheets to the conveying path **105** is sequentially executed through the feeding conveying path **109**. When all the sheets are finally discharged to the discharge tray **31***b*, the recovery operations are terminated.

(Continuous Operation Process at Abnormal Time)

Next, reference will be made to a series of continuous operations of the image forming apparatus according to this first embodiment at an abnormal time thereof. In FIG. **13**, there is shown a flow chart of this image forming apparatus.

As shown in FIG. **13**, in this first embodiment, first in step S**1301**, the CPU **401** determines, based on the output of the

separation sensor **96** or the like, whether a second heating device in the form of a fixing unit **111** (see FIG. **10**) is normal. When the fixing unit **111** is normal (S**1301**: YES), the control flow shifts to step S**1302**.

In step S**1302**, the CPU **401** determines, based on the outputs of the optical sensors **98**, **99**, **100** or the like, whether a cutting device in the form of a cutter portion **112** is normal. When it is determined in step S**1302** that the cutter portion **112** is normal, the control flow shifts to step S**1303** where an ordinary sequential operation is executed by the CPU **401**. Then, the control flow shifts to step S**1304** where the pieces of recording paper P to be output are discharged to the discharge tray **31***b* according to an output order.

Thereafter, the control flow shifts to step S**1305** where the CPU **401** determines whether the last piece of recording paper P in that job has been output. In this first embodiment, a determination as to whether the fifth piece of output paper has been output is made by the CPU **401**. When the last piece of recording paper P (here, the fifth sheet P**5**) has been output, the control flow goes to step S**1306** where the output operation is completed.

On the other hand, when the CPU **401** determines in step S**1301** that the fixing unit **111** is abnormal (S**1301**: NO), or when the CPU **401** determines in step S**1302** that the cutter portion **112** is abnormal (S**1302**: NO), the control flow shifts to step S**1307** where the CPU **401** controls to stop the operation sequence of the abnormal unit or portion. Specifically, in step S**1307**, the CPU **401** controls to stop the operations of the fixing belt **56** and the conveyance rollers **77**, **78**, **79**, **80**, **82**.

Then, the control flow shifts to step S**1308** where the CPU **401** determines whether the recording paper P exists on the conveying path **104**.

When the CPU **401** determines that there exists no recording paper P on the conveying path **104** (S**1308**: NO), the control flow shifts to step S**1311** where the CPU **401** determines whether the recording paper P has been removed from a part where the conveyance abnormality of the recording paper P has occurred. The image forming process by the image forming apparatus is made to wait until the recording paper of which the conveyance was stopped upon occurrence of the abnormality is removed. At the time when the recording paper P in the abnormal unit has been removed, the control flow shifts again to step S**1311** where an ordinary image forming operation is executed in step S**1311**. That is, the sheet, having been subjected to the jam processing in the image formation, is removed, and an image forming process is carried out on a new recording paper in the image forming apparatus main body A. After that, the control flow shifts to step S**1305**.

When the CPU **401** determines in step S**1308** that there exists recording paper P on the conveying path **104** (S**1308**: YES), the control flow shifts to step S**1309**. In step S**1309**, the CPU **401** controls the driving of the conveyance rollers **70**, **71**, **72**, **73**, **74** and the operation of the flapper **107** so as to discharge the recording paper P existing on the conveying path **104** to the discharge tray **31***a*. Here, the third sheet P**3**, the fourth sheet P**4** and the fifth sheet P**5** are sequentially discharged to the discharge tray **31***a*. Thereafter, the control flow shifts to step S**1310** where the CPU **401** executes a recovery operation.

In addition, after the termination of the recovery operation in step S**1310**, the control flow shifts to step S**1306** where the output operation is completed, as stated above, at the time when it is verified that the last piece of recording paper P (here, the fifth sheet P**5**) in the job in step S**1305** has been output. Here, note that after the completion of the output operation, the image forming apparatus main body A is restored to a standby state.

(Recovery Operation)

Next, detailed reference will be made to the recovery operation of the image forming process according to this first embodiment by using a flow chart in FIG. **14**.

As shown in FIG. **14**, first in step S**1401**, the CPU **401** controls the display of an annunciation portion in the form of a display device **908** in such a manner as to inform the user to set pieces of recording paper P (here, the third sheet P**3** through the fifth sheet P**5**, and hereinafter referred to as retraction sheets) discharged to the discharge tray **31***a* into the paper refeeding unit **103**. Here, the CPU **401** controls the display device **908** in such a manner that the display device **908** displays an indication "Please set the sheets discharged to a tray at a side of the apparatus onto a tray on an upper surface of the apparatus". Although the annunciation portion in the form of a displayed indication of the display device **908** for information to the user has been exemplified herein, there may be adopted, as such an annunciation portion, other methods such as displaying such an indication on an operation panel (not shown) in the image forming apparatus, etc. In addition, as an information method for the annunciation portion, there may be adopted any methods such as outputting a voice, blinking a diode, etc., as long as the user can recognize the intended information by such methods. In this case, the CPU **401** is constructed so as to control the output of the voice or blinking of the diode in the annunciation portion.

Then, the control flow shifts to step S**1402** where the CPU **401** determines whether all the retraction sheets have been set in the paper refeeding unit **103**. Here, it is determined whether the third sheet P**3** through the fifth sheet P**5** have been loaded and received in the paper refeeding unit **103**. Such a determination as to whether the retraction sheets have been set in the sheet feeding unit **103** is made by the CPU **401** based on the output of the presence or absence detecting sensor **103***b* that detects the presence or absence of a sheet on the paper refeeding tray **103***a*. At the time when all these retraction sheets have been set, the control flow shifts to step S**1403**. Although there has been exemplified a form in which a determination as to whether the retraction sheets have been set in the sheet feeding unit **103** is made by the CPU **401** based on the output of the presence or absence detecting sensor **103***b*, it may instead be constructed such that the user is prompted to input the purport of the completion of setting, and the CPU **401** determines, based on the user's input, the completion of setting of the retraction sheets in the sheet feeding unit **103**.

In step S**1403**, the CPU **401** determines whether the recording paper P has been removed from a part where the conveyance abnormality of the recording paper P has occurred. Here, the CPU **401** determines whether the jam clearance operation of the first sheet P**1** and the second sheet P**2** has been performed. The image forming process by the image forming apparatus is made to wait until the first sheet P**1** and the second sheet P**2** of which the conveyance was stopped upon occurrence of the abnormality is removed. At the time when these pieces of recording paper P in the abnormal unit have been removed, the control flow shifts again to step S**1311** where an ordinary image forming operation is executed in step S**1404**. Specifically, the first sheet P**1** and the second sheet P**2** on which the jam clearance process in the image formation has been carried out are discarded, and the image forming process to a first sheet P**1** and a new second sheet P**2** is performed in the image forming apparatus main body A. An image is freshly formed on the first sheet P**1** and the second sheet P**2**. Thereafter, in step S**1405**, the CPU **401** makes a

determination as to whether the last sheet of the abnormal unit, i.e., the second sheet P2 in this case, has been conveyed to the above-mentioned fixing unit.

When the CPU **401** determines that the last one of the sheets on which the image is newly formed have been conveyed to the fixing unit **50**, the control flow shifts to step S**1406**. In step S**1406**, the CPU **401** controls the paper refeeding unit **103** so as to feed the retraction sheets (the third through fifth sheets P**3**, P**4**, P**5**) thus set in a sequential manner. The order of feeding here is as follows: the third sheet P**3**, the fourth sheet P**4** and the fifth sheet P**5**. In step S**1407**, the CPU **401** determines whether all of the retraction sheets set in the paper refeeding unit **103** have been output, and when all the sheets have been discharged, the control flow shifts to step S**1408** where the recovery operation is terminated.

As described in the foregoing, according to this first embodiment, there can be obtained a fixing unit and an image forming apparatus provided with such a fixing unit which, upon occurrence of an abnormality, can perform restoration operation without excluding or discarding recording paper wastefully.

Although in the foregoing description, one or the first embodiment of the present invention has been specifically described, the present invention is not limited to the above-mentioned embodiment, and the invention can be varied into a variety of forms based on the technical thought of the present invention. For example, materials and the like enumerated in the above-mentioned one or first embodiment are merely some examples, so materials different from these may be used as required.

(Outline of the Operation at Abnormal Time in a Second Embodiment)

Next, reference will be made to the outline of a series of continuous operations of an image forming apparatus according to a second embodiment at an abnormal time. Here, an exemplary case will be described in which an image is continuously output in three sheets of paper in a photograph mode.

As shown in FIG. **15**, a first sheet P**1** on which an image is formed by an image forming apparatus main body A is conveyed on a fixing belt **56** through conveying paths **104**, **105** according to a predetermined sheet conveyance sequence.

Thereafter, in case of the occurrence of an abnormality in which the first sheet P**1** is not peeled or separated from the fixing belt **56**, such a state of non-separation of the first sheet P**1** is detected by a separation sensor **96** in the form of an optical sensor. At this time, a second sheet P**2** is conveyed in the conveying path **105**, and a leading end of the second sheet P**2** has not yet arrived at the fixing belt **56**. The third sheet P**3** is conveyed over a conveying path **46** and the conveying path **104** of the image forming apparatus main body A.

Here, when the CPU **401** determines based on the output of the separation sensor **96** that the first sheet P**1** is not peeled from the fixing belt **56**, the CPU **401** controls to stop the conveyance roller and the fixing belt so that the conveyance of the first sheet P**1** **1**, the second sheet P**2** and the third sheet P**3** in the fixing unit **50** are stopped, and a temperature adjusting operation is stopped in response to the stopping of the conveyance of the respective sheets.

Thereafter, the CPU **401** controls the rotation of conveyance rollers **60**, **63**, **73**, **72** in such a manner that the second sheet, of which the leading end lies downstream of a branch portion **301** and does not reach the fixing belt **56**, is conveyed in a direction opposite to the ordinary conveying direction. The conveyance of the second sheet P**2** in the direction opposite to the ordinary conveying direction is carried out until the leading end of the second sheet P**2** reaches a location upstream of the branch portion **301** (see FIG. **16**). After that, a flapper **107** is controlled by the CPU **401** so as to be swung to a position to guide a recording paper to a discharging conveying path **108**, and the second sheet P**2**, which has been conveyed until the leading end thereof reaches a location upstream of the branch portion **301**, and the third sheet P**3** are conveyed in the ordinary conveying direction. As the flapper **107** is located at a position to guide the recording paper to the discharging conveying path **108**, the second sheet P**2** and the third sheet P**3** are guided to the discharging conveying path **108** side to be discharged onto the discharge tray **31***a*.

In other words, when it is determined based on the output of the separation sensor **96** that abnormality occurred in a second heating device, the CPU **401** controls in such a manner that the recording paper, which lies at the downstream side of the branch portion **301** and has not reached the second heating device, is conveyed to a location upstream of the branch portion **301**. Thereafter, in order to discharge the recording paper (the second sheet P**2**), which has been conveyed to the upstream side of the branch portion **301** through the discharging conveying path **108**, and the recording paper (the third sheet P**3**) originally existing at the upstream side of the branch portion **301** to the outside of the apparatus, the CPU **401** controls the flapper **107** to swing downwardly, and at the same time controls conveyance rollers **70**, **71**, **72**, **73**, **74** to discharge these pieces of recording paper upstream of the branch portion **301** through the discharging conveying path **108**.

(Continuous Operation Process at Abnormal Time)

Next, reference will be made to a series of continuous operations of the image forming apparatus according to this second embodiment at an abnormal time thereof. In FIG. **17**, there is shown a flow chart of this image forming apparatus.

As shown in FIG. **17**, in this second embodiment, first in step S**1501**, the CPU **401** determines, based on the output of the separation sensor **96** or the like, whether the second heating device in the form of a fixing unit **111** (see FIG. **10**) is normal, and when the fixing unit **111** is normal (S**1501**: YES), the control flow shifts to step S**1502**.

In step S**1502**, the CPU **401** determines, based on the outputs of optical sensors **98**, **99**, **100** or the like, whether a cutting device in the form of a cutter portion **112** is normal. When it is determined in step S**1502** that the cutter portion **112** is normal, the control flow shifts to step S**1503** where an ordinary sequential operation is executed by the CPU **401**. Then, the control flow shifts to step S**1504** where the pieces of recording paper P to be output are discharged to a discharge tray **31***b* according to an output order.

Thereafter, the control flow shifts to step S**1505** where the CPU **401** determines whether the last piece of recording paper P in that job has been output. In this second embodiment, a determination as to whether the third piece of output paper has been output is made by the CPU **401**, and when the last piece of recording paper P (here, the third sheet P**3**) has been output, the control flow goes to step S**1506** where the output operation is completed.

On the other hand, when the CPU **401** determines in step S**1501** that the fixing unit **111** is abnormal (S**1501**: NO), or when the CPU **401** determines in step S**1502** that the cutter portion **112** is abnormal (S**1502**: NO), the control flow shifts to step S**1507**. In step S**157**, the CPU **401** controls to stop the conveying operation of the recording paper. Specifically, in step S**1507**, the CPU **401** controls to stop the operations of the fixing belt **56** and the conveyance rollers **77**, **78**, **79**, **80**, **82**.

Then, the control flow shifts to step S**1508** where the CPU **401** determines whether recording paper P exists on the conveying path **105**. Here, note that whether recording paper P

exists in the conveying path **105** means whether there exists a sheet having its leading end located downstream of the branch portion **301** and upstream of the fixing belt **56**. Here, note that a determination as to whether recording paper P exists in the conveying path **105** is made by the CPU **401** based on the detection of a leading end of a sheet by means of a registration sensor **62**, the distance of the sheet that is conveyed by a conveyance roller **60** from the time point of detection of the leading end thereof by the registration sensor **62** to the time point of occurrence of an abnormality.

When the CPU **401** determines in step S**1508** that there exists recording paper P on the conveying path **105** (S**1508**: YES), the control flow shifts to step S**1509**. In step S**1509**, the CPU **401** controls the rotation of the conveyance rollers **60**, **73** so as to convey the recording paper P existing on the conveying path **105** in a direction opposite to an ordinary conveying direction (in a direction toward the conveying path **104**). The CPU **401** terminates the conveyance of the recording paper based on the fact that an end of the recording paper, being conveyed in the direction opposite to the ordinary direction so as to be conveyed up to a location where the end of the recording paper reaches upstream of the branch portion **301** (a side of the conveying path **104**), has been detected by an optical sensor **93** located at an upstream side of the branch portion **301**. After that, in step S**1510**, the CPU **401** controls the driving of the conveyance rollers **70**, **71**, **72**, **73**, **74** and the operation of the flapper **107** so as to discharge the recording paper existing on the conveying path **104** upstream of the branch portion **301** to the discharge tray **31***a*. Here, the second sheet P**2** and the third sheet P**3** returned to the conveying path **104** are sequentially discharged to the discharge tray **31***a*. Thereafter, the control flow shifts to step S**1511** where the CPU **401** executes a recovery operation. The recovery operation is similar to that in the first embodiment shown in FIG. **14**, and hence a description thereof is omitted.

In addition, after the termination of the recovery operation step S**1511**, the control flow shifts to step S**1506** where the output operation is completed, as stated above, at the time when it is verified that the last piece of recording paper P (here, the third sheet P**3**) in the job in step S**1505** has been output. Here, note that after the completion of the output operation, the image forming apparatus main body A is restored to a standby state.

When the CPU **401** determines in step S**1508** that there exists no recording paper P on the conveying path **104** (S**1508**: NO), the control flow shifts to step S**1512**. In step S**1512**, it is determined by the CPU **401** whether recording paper exists in the conveying path **104**. When the CPU **401** determines that there is recording paper in the conveying path **104**, the control flow shifts to step S**1510** where the CPU **401** performs the above-mentioned processes.

On the other hand, when the CPU **401** determines that there is no recording paper in the conveying path **104**, the control flow shifts to step S**1513**. In step S**1513**, the CPU **401** determines whether the recording paper P has been removed from a part where the conveyance abnormality of the recording paper P has occurred. That is, the image forming process by the image forming apparatus is made to wait until the recording paper of which the conveyance was stopped upon occurrence of the abnormality is removed. At the time when these pieces of recording paper P in the abnormal unit have been removed, the control flow shifts to step S**1514** where an ordinary image forming operation is executed. That is, the sheet, having been subjected to the jam processing in the image formation, is removed, and an image forming process is carried out on a new recording paper in the image forming apparatus main body A. After that, the control flow shifts to step S**1505**.

While the invention has been described in terms of preferred embodiments, those skilled in the art will recognize that the invention can be practiced with modifications within the spirit and scope of the appended claims.

While the present invention has been described with reference to exemplary embodiments, it is to be understood that the invention is not limited to the disclosed exemplary embodiments. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures and functions.

This application claims the benefit of Japanese Patent Application No. 2005-265571, filed Sep. 13, 2005 which is hereby incorporated by reference herein in its entirety.

What is claimed is:

1. An image forming apparatus comprising:

a first heating device which heats a sheet with a toner image formed thereon;

a second heating device which heats said sheet heated by said first heating device;

a first conveying path which conveys said sheet conveyed from said first heating device to said second heating device;

a second conveying path which branches from said first conveying path at a location upstream of said second heating device in said first conveying path for conveyance of said sheet without conveying it to said second heating device;

a discharge tray to which said sheet being conveyed on said second conveying path is discharged;

a feeding portion which feeds sheets put on a paper refeeding tray; and

a feeding conveying path which conveys a sheet fed by said feeding portion to said second heating device, said feeding conveying path having a downstream portion merged into said first conveying path at a location between said first heating device and said second heating device;

an abnormality control portion which issues an abnormality factor that occurs in said second heating device, and a sheet located upstream of said branch portion in said first conveying path is discharged to said discharge tray through said second conveying path; and

an annunciation portion is provided which serves to inform that said sheet discharged to said discharge tray should be set in said refeeding tray when said sheet has been discharged to said discharge tray upon occurrence of the abnormality factor in said second heating device.

2. The image forming apparatus according to claim **1**, wherein

after said abnormality factor in said second heating device is removed and said sheet discharged to said discharge tray through said second conveying path is put on said paper refeeding tray, said sheet put on said paper refeeding tray is fed by said feeding conveying path.

3. The image forming apparatus according to claim **1**, wherein

said second heating device includes a heating portion and a cooling portion, and provides a luster to the image on said sheet by heating said sheet, which has been heated by said first heating device, by means of said heating portion, and by cooling said sheet thus heated by means of said cooling portion.

4. The image forming apparatus according to claim **3**, wherein

said second heating device comprises a fixing roller, a rotating roller which is arranged at a predetermined distance from said fixing roller, an endless belt which is

wrapped around said fixing roller and said rotating roller so as to be rotated therebetween, and a pressure roller which is arranged so as to face said fixing roller and placed in pressure contact with said fixing roller while clamping said endless belt therebetween; and

said cooling portion cools said sheet in a portion of said endless belt between said fixing roller and said rotating roller.

5. The image forming apparatus according to claim **1**, further comprising:

a cutting device that is arranged at a downstream side of said second heating device in a direction to convey said sheet for cutting said sheet that is heated by said second heating device.

6. The image forming apparatus according to claim **1**, wherein

said sheet is formed on at least one surface thereof with a layer comprising a thermoplastic resin.

7. An image forming apparatus comprising:

a first heating device which heats a sheet with a toner image formed thereon;

a second heating device which heats said sheet heated by said first heating device;

a first conveying path which conveys said sheet conveyed from said first heating device to said second heating device;

a second conveying path which branches from said first conveying path at a branch portion upstream of said second heating device in said first conveying path for discharging said sheet without conveying it to said second heating device;

a discharge tray to which said sheet being conveyed on said second conveying path is discharged;

a feeding portion which feeds sheets put on a paper refeeding tray; and

a feeding conveying path which conveys a sheet fed by said feeding portion to said second heating device, said feeding conveying path having a downstream portion merged into said first conveying path at a location between said first heating device and said second heating device;

an abnormality control portion which issues an abnormality factor that occurs in said second heating device, and a sheet existing between said branch portion and said second heating device in said first conveying path is conveyed upstream of said branch portion, and the sheet thus conveyed upstream of said branch portion is discharged onto said discharge tray through said second conveying path.

8. The image forming apparatus according to claim **7**, further comprising:

an annunciation portion which serves to inform that said sheet discharged to said discharge tray should be put on said refeeding tray, when said sheet has been discharged to said discharge tray upon occurrence of said abnormality factor in said second heating device.

9. A sheet heating apparatus comprising:

a first conveying path which conveys a sheet being conveyed from an image forming apparatus main body that includes an image forming portion for forming a toner image on said sheet and a first heating device for heating said sheet having said toner image formed thereon by means of said image forming portion;

a second heating device which heats said sheet being conveyed on said first conveying path;

a second conveying path which branches from said first conveying path at a branch portion upstream of said second heating device in said first conveying path for discharging said sheet without conveying it to said second heating device;

a discharge tray to which said sheet being conveyed on said second conveying path is discharged;

a feeding portion which feeds sheets put on a paper refeeding tray; and

a feeding conveying path which conveys a sheet fed by said feeding portion to said second heating device, said feeding conveying path having a downstream portion merged into said first conveying path at a location between said first heating device and said second heating device;

an abnormality control portion which issues an abnormality factor that occurs in said second heating device, and a sheet located upstream of said branch portion is discharged onto said discharge tray through said second conveying path; and

after said abnormality factor in said second heating device is removed and said sheet discharged to said discharge tray through said second conveying path is set in said paper refeeding tray, said feeding conveying path feeds the sheet set in said paper refeeding tray to said second heating device.

10. The sheet heating apparatus according to claim **9**, further comprising:

an annunciation portion which serves to inform that said sheet discharged to said discharge tray should be put on said refeeding tray, when said sheet has been discharged to said discharge tray upon occurrence of said abnormality factor in said second heating device.

11. The sheet heating apparatus according to claim **9**, wherein

when an abnormality factor occurs in said second heating device, a sheet existing between said branch portion and said second heating device in said first conveying path is conveyed upstream of said branch portion, and said sheet thus conveyed upstream of said branch portion is discharged onto said discharge tray through said second conveying path.

12. The sheer heating apparatus according to claim **9**, wherein

said second heating device includes a heating portion and a cooling portion, and provides a luster to the image on said sheet by heating said sheet, which has been heated by said first heating device, by means of said heating portion, and by cooling said sheet thus heated by means of said cooling portion.

13. The sheet heating apparatus according to claim **12**, wherein

said second heating device comprises a fixing roller, a rotating roller which is arranged at a predetermined distance from said fixing roller, an endless belt which is wrapped around said fixing roller and said rotating roller so as to be rotated therebetween, and a pressure roller which is arranged so as to face said fixing roller and placed in pressure contact with said fixing roller while clamping said endless belt therebetween; and

said cooling portion cools said sheet in a portion of said endless belt between said fixing roller and said rotating roller.

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